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Castings Give Access To Subterranean Passages

AS CIVILIZATION becomes more complex and the demands of the human race increase, cities find it necessary more and more to utilize the sections under the ground. Sewers and water pipes first were placed under the streets. Then gas was introduced and pipes were laid to carry that commodity to the public. Later the telephone and the electric light

Castings Guard Entrances to Subterranean Conduits for Wires and Pipes

were invented and soon the streets became cluttered with poles carrying a multiplicity of wires throughout the city. Public utilities and city officials saw the advisability of removing the wires from the streets and the work of placing them in conduits under ground was begun. Today, practically all wires in the business sections of the larger cities are below the surface and the work is extending to the suburban districts. Large cities have built subways to carry the enormous crowds with great speed. In all of the work of placing pipes, wires, sewers and subways under ground, castings have played an important part. City streets, especially in the business district, are dotted with manholes, of which the top section including the cover is constructed of cast iron. Valve boxes for water, gas and steam lines, catch basins and some parts of subway ventilators are made of iron castings.

Find Where Castings Can Be Sold

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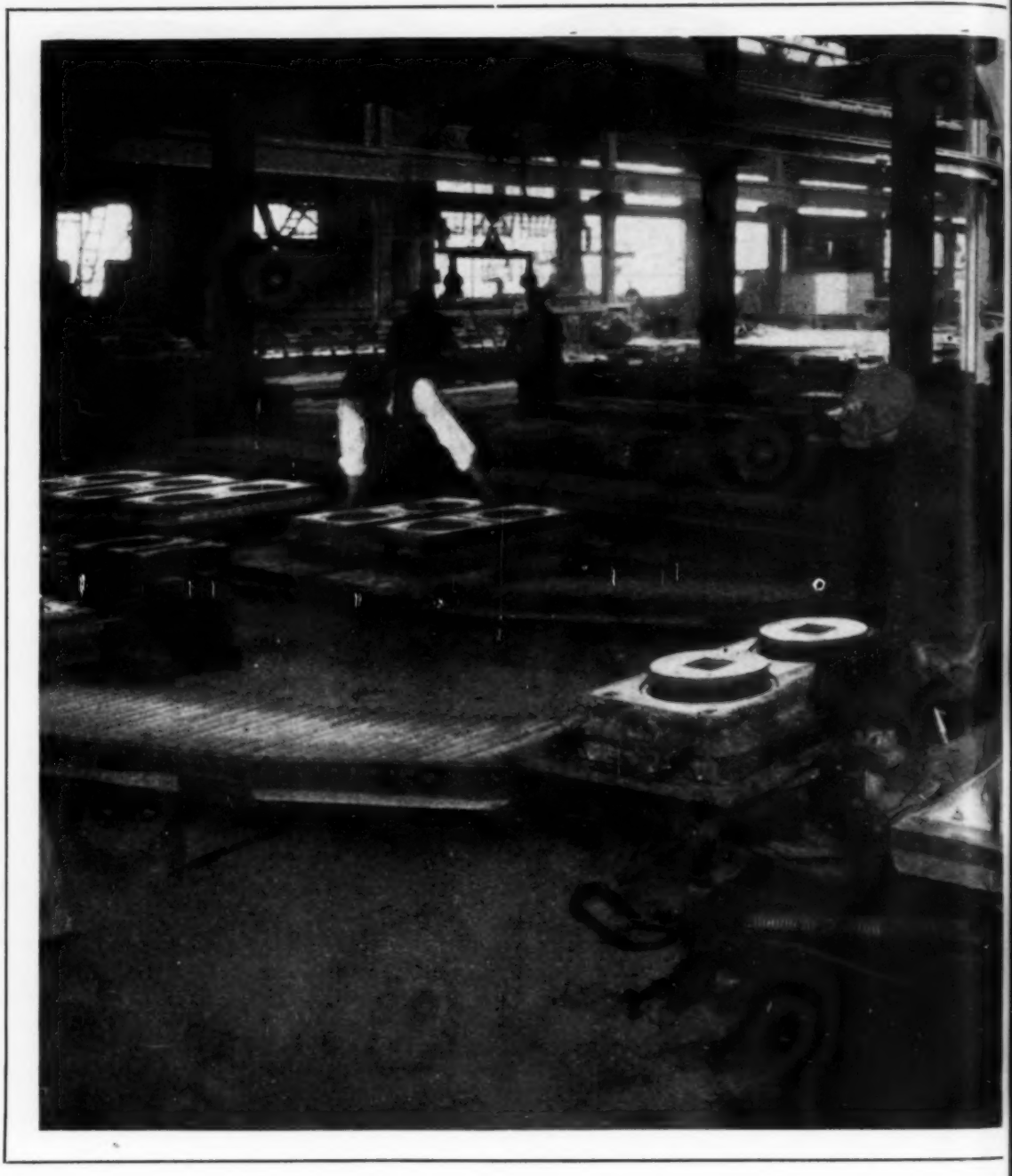


Fig. 1—Even on Heavy Molds One Man Handles the Work of Each Molding Machine

By *Herbert R. Simonds*

Lowers Cost of S

A CAREFULLY planned materials handling system is one of the chief factors to spell profits for a large steel foundry formerly operating in the red ink. This plant, now operated as the Eastern Steel Castings Co., Newark, N. J., was acquired by its present owners about four years ago, at which time it enjoyed a fair demand for miscellaneous steel castings, but suffered under a handicap of high manufacturing costs. Today the plant is operated at a profit and many changes have contributed to this decrease in cost of production.

Many of these changes have had to do with better and cheaper methods of handling and transporting materials. In some departments of the plant the production costs have been reduced as much as 25 per cent. The new management found a poorly arranged plant with material in process traveling back and forth needlessly and most of the handling done actually by hand.

The plan of the foundry was U-shaped. The main central room was used as an open-hearth de-

Sand Is Delivered From Overhead Hoppers and the Completed Mold Is Carried Away by Gravity

# of STEEL CASTINGS

partment, casting shop and cleaning room and was served by cranes. At each end of this room were large wings, the left one containing the core department, the electric furnace and molding room, and the right wing housing the cleaning and shipping department for the electric steel castings. With the exception of two relatively small doors, the left wing was separated from the main room by a brick wall. In this isolated wing the molding floor for the electric furnace was located. It was not served by cranes.

While an unhandy arrangement of the plant was at once apparent, the new manager soon found that the general practice was inefficient. This will be illustrated by an incident which happened soon after he took over the work of modernization. He noticed that the molders went after their own cores, their patterns and even their flasks, instead of having these brought to them in the usual manner. He asked the foreman why the cores were not delivered to the molders, and the foreman's reply was that the

Fig. 2—Modern Machinery Is Used in Making and Handling Cost or Production Control Records

workmen needed the change and rest which they got from walking about to collect the sundries mentioned. He added, "If we supply them with cores, they are going to take time to rest just the same and while they're resting they might as well get their cores."

After this incident the new manager decided not only that the physical part of the plant needed changing, but that a whole new system of operation would have to be followed. Accordingly, he worked out a careful plan of procedure. This may be divided in a general way under two main headings:

(1) Rearrangement of departments and new equipment.

(2) Planning control and piece work pay.

Of course it is difficult to classify the many changes called for in the rehabilitation of an old plant under any two divisions, and some idea of the diversified features considered may be had from the following list: time study; control and research laboratory; five day week; duplexing with an open hearth and an electric furnace; bonus system; heading and gating committee; one grade of sand.

As in most every other case of plant modernization, the problem of economy had to be considered. Features of the old plant had to be retained as much as possible, and production during these changes could not be interrupted. In attempting to establish a progressive flow of material from one side of the plant to the other, the manager's first thought was how to get all the raw material started at any one point.

The open-hearth furnace was at the center of the plant, and the electric furnace as mentioned was in the left wing. The cost of moving either furnace seemed prohibitive. While studying this problem he recalled having heard of some plants where duplexing had proved successful. Accordingly he visited these plants and after considerable study decided to use his open-hearth furnace as a melting unit and to refine the steel in the electric furnace.

This gave him his starting point for metal at one side instead of at the center and was in fact a feature which determined many of the subsequent alterations. To get the metal from the open-hearth furnace to the electric furnace, he tore down the separating wall and extended the crane runway across the left wing. This apparently simple expedient of tearing down a wall proved to be an in-

Fig. 3—A Special Chain Sling With Pulleys Permits Ease in Handling Flasks and Closing Molds

spiration in the work of improvement. Not only did this at once give better lighting throughout the whole central part of the plant, but it opened the way for freedom in arrangement of conveyors and equipment which had been blocked by the existence of the wall. His advice to others facing the problem of modernizing an old plant is to tear out at once all inner walls not needed to support the roof. This advice might have to be modified in the case of storage bins, but even in that case bins not extending to the roof are preferable to those with extremely high sides.

With the source of steel arranged for the left wing, the sand conditioning equipment and sand storage were placed in the left wing. The coreroom was left about where it had been near the upper end of the left part of the U. However, the core oven which had been almost in the center of the left wing was moved out of the way to one side of the building. The coreroom itself was completely reorganized and was equipped with modern core benches and core making machines to decrease the cost of production.

Realizing the importance of sand both in its relation to quality of work and expense, the new management gave special study to its sand system. From the vibrating shake-out, the castings continue on in their travel to the cleaning department.

Fig. 5—All Incoming Orders Are Given First to the Planning Committee Which Studies Gating, Plans the Production and Outlines the Methods

The empty flasks are returned by conveyors to the flask storage department and the sand drops through a grating upon a belt conveyor which carries it past a magnetic separator to a vibrating screen and then to a dust extractor before it goes to the storage bin for reused sand. After mixing in proper proportion with new sand and bond, it is fed on to a belt conveyor which in turn delivers it to an elevator where it passes to the sand mills. After milling and conditioning, the sand is carried by overhead belt conveyors to the sand hoppers which serve all molding machines.

The moisture content of the sand is automatically controlled and a humidity indicator located at the point where the conditioned sand goes on to the last conveyor belt is electrically connected with the laboratory, giving a direct and continuous reading on a dial. By this means the laboratory attendant can check with the automatic control. In addition samples of the sand are taken and tested

Fig. 4—Molds Are Poured on the Conveyors, the Metal Being Delivered in Ladles Carried on Overhead Trolleys

Fig. 6—Molds for Small Castings Are Grouped on Long Bottom Boards and Carried Forward for Pouring by Ingenious Roller Conveyors

every hour for strength and other properties. The moisture content is held within a quarter of one per cent of the specified value which is slightly less than three per cent of the sand by weight. One innovation in the sand system which has been highly successful is the elimination of backing sand. Under the new scheme one grade only is used. This is a uniformly conditioned facing sand.

By giving careful attention to the sand department not only have casting losses been reduced, but the amount of new sand used has been reduced from an average of 2000 pounds per ton of castings with the old plant to 400 pounds per ton of castings with the new. The complete sand cycle requires but four men to operate it, including maintenance of the conveyor system.

With the exception of the core department roller conveyors have been installed throughout the entire plant for handling nearly all the material. These conveyors have been standardized as much as possible and have been made up in sections so that they may be switched from one location to another until the best arrangement has been secured. These conveyors in general are placed 12 inches above the floor level. They handle the molds from the molding machines to cross conveyors for pouring and then on to the shakeout. From the shakeout, roller conveyors continue to transport the castings, always in the same general direction, on through the various phases of inspection and cleaning to the shipping department which occupies a large space at the right.

To use roller conveyors for the green molds, it is necessary to build them along the lines of a precision machine so that there will be no wobbling or vibration transmitted to the molds. This difficult problem has been solved by the Eastern Steel Castings Co. The precision feature has been secured by the use of heavy angle supports, machine drilled to an accurate center line to take the roller shafts. The rollers and bearings all are designed to insure that all rollers have their top or bearing surfaces in one plane and that each roller is concentrically mounted so that its bearing surface remains in this plane.

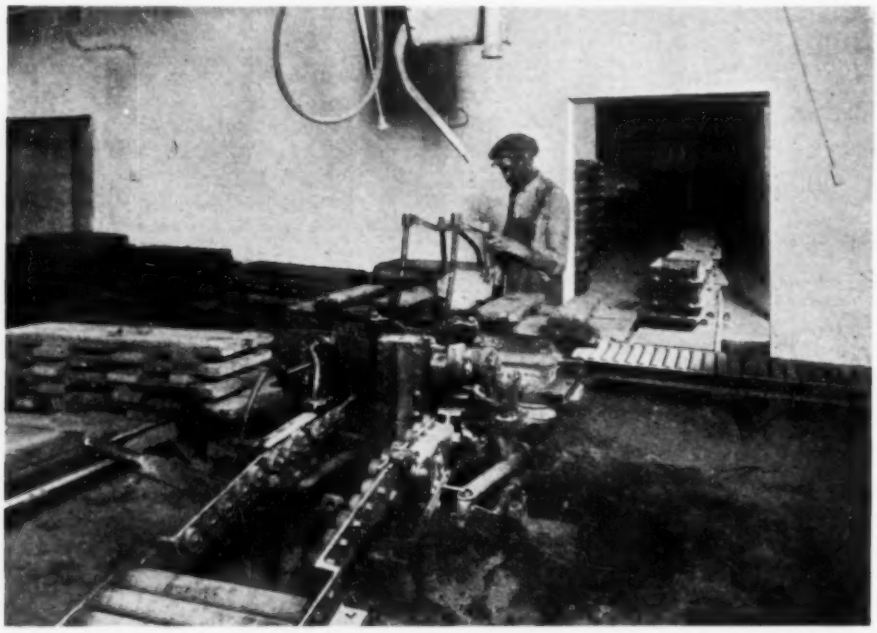


Fig. 7—Gravity Conveyors Bring Flasks and Bottom Boards to Molding Stations and Carry Away the Finished Molds

System Has Flexibility

The conveyors extending out from the molding machines are of sufficient length to give ample storage space. As a rule, the molds are closed at the far end of such branch conveyor lines permitting flexibility in the number of operators and in the time used for different operations. Fig. 7 illustrates a typical layout of conveyor and molding machine. In this case the copes are made on one machine which has its own branch conveyor and the drags are made on an adjacent machine served by a parallel conveyor. The molds are closed at the lower end of these conveyors by the special chain and pulley closing mechanism illus-

trated in Fig. 3. Under this general plan two men are able to pick up the copes and place them on the adjacent drags at the rate of 35 molds per hour.

A feature of the application of the conveyor to the molding machine is that the rollers extend in under the work so that the molder merely drops a lever after the mold has been jolted and without any lifting or pushing on his part the completed mold moves off on the conveyor. Roller conveyors in many other installations are brought up to molding machines and stopped short of the rollover table which means that for heavy work two men are required to lift the molds off the machine on to the conveyor however close it may be.

Output Doubled

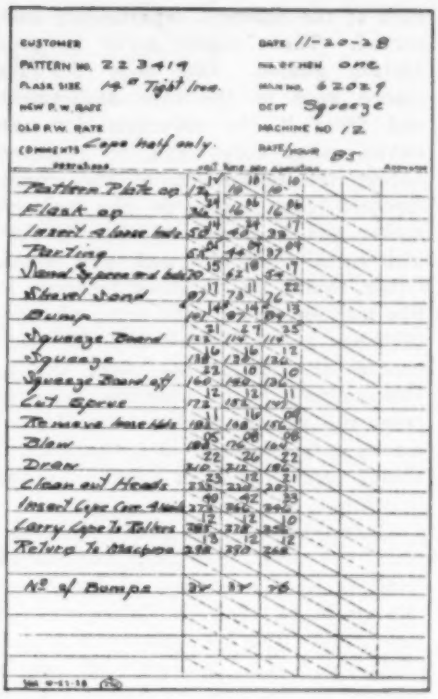
The entire production of the foundry is now electric steel, the open-hearth work having been switched to electric steel at the time the duplexing operation was established. The castings range in size from less than a pound to more than 6 tons and include such work as motor frames, gears, gear blanks, headers for oil stills, automotive castings, railroad castings, steel valves and fittings, hydraulic pressure cylinders and mooring posts.

The electric furnace is the 3-phase arc type, rated by the manufacturers at 1½ tons per hour. Under the present system this same furnace refines about 12,000 pounds per heat, or with two shifts and figuring on a 55 per cent yield, 180 tons of finished castings a week.

The usual charge of scrap, pig iron and sprue is fed into the open-hearth furnace and after melting is tapped into a large crane ladle and carried through to be used as a charge for the electric furnace. The net result of this duplexing operation is an improved quality of castings for the general run of the plant, a greater capacity in electric steel with no additional equipment, and lower costs of production.

These lower costs are made possible through many incidental changes. As the open hearth furnace is now used merely as a melting unit, only one expert melter is required, his work being confined to the electric furnace. Heretofore it was necessary to have a melter at each furnace. The working hours on the furnace have been greatly shortened. The melting of scrap and pig iron in an electric furnace from the cold state is a slow process and many devices have been adopted by foundrymen to offset part of this difficulty. Such methods include pre-heating outside of the furnace, pre-heating inside of the furnace, and the introduction of oil jets during the first part of the electric melting. The Eastern Steel Castings Co. believes that an open hearth furnace used as the initial melting unit gives the best results. This opinion must be tempered a little by the fact that the management found the plant equipped with an open hearth furnace in good working order and consequently was ready to do melting in that manner.

Second only to the physical aspect of a plant comes the planning department in the mind of the management. This planning department at the East-


CUSTOMER — DATE 11-20-28
PATTERN NO. 22 3419 — NO. OF MEN ONE
FLASK SIZE 14" Tight Iron — MAIN NO. 6202.9
NEW P.W. GATE — DEPT Squeeze
OLD P.W. GATE — MACHINE NO 12
COMMENTS Cope half only — DATE/HOUR 85

OPERATIONS						
Pattern Plate up	14	18	18	10		
Flask up	34	16	16	16		
Insert & close hole	58	44	34	17		
Peening	84	94	97	84		
Stand Sprue and hole	35	62	18	54	17	
Shovel Sand	97	78	11	76	22	
Bump	146	97	14	84	13	
Squeeze Board	31	21		25		
Squeeze	136	120	36	120	12	
Squeeze Board off	22	10		10		
Cut Sprue	160	150	12	130	10	
Remove Handles	12	12	12	11		
Blow	95	108	16	105	10	
Draw	200	150	08	100	06	
Clean out Heads	22	20	24	22		
Insert Cope Core & Vent	235	232	12	180	22	
Carry Cope To Tables	279	260	42	205	23	
Return To Machine	12	12	12	10		
	288	278	250	248	12	
No of Bumps	24	32	26			

Fig. 9—A Simple Time Study Card Gives Full Data Necessary in Computing Rates and Setting Prices for Piecework Pay

ern Steel Castings Co. covers time study work, routing and scheduling and the pay of workers. The operation of the department is highly complicated and only a brief outline can be given here.

After having passed through the preliminary stage of estimating and quoting, incoming orders go to the planning department for first attention. From the customer's order a work order is made out with four or five copies and one copy is sent to

Fig. 8—Tote Boxes Carry the Castings to the Heat Treating Furnaces and Thence to the Shipping Department

each of the different departments concerned. These copies serve as production guides. One copy for instance goes to the core department and from it the coreroom foreman knows what cores will be required during the production of the order. Another copy goes to the pattern maker and is a notice to him to furnish certain patterns and core boxes. Other copies go to other foremen in like manner. The work order also establishes a definite schedule for each process throughout the plant and in combination with progress reports from the various foremen enable the manager to check up each phase as to actual performance in relation to the schedule.

The subject of time study is a bugbear to some foundries and many methods have been devised for determining in advance the labor cost on new work. The form shown in Fig. 9 illustrates the method of study adopted by the Eastern Steel Castings Co.

The notations on the left are the different operations called for in making up the cope half only of pattern No. 223419. The three columns to the right of this list of operations are the three tests made as a time study of the job. In each column the left hand figures are cumulative, each one representing a point caught by the stop watch. The right hand figures in each column are secured by subtracting any one item from its succeeding item and they thus give values for each single operation.

This is the crux of the whole scheme. Time values for each operation taken during the sequence of all operations are then compared with standards already set up for these operations and after checking with similar time values obtained in the other tests shown on the card, new values are set for each operation. These new values when totaled give the time allowance for the job. The method breaks down total time into operation time and in this way helps establish certain standards which are common to many jobs. Eventually these standards make it possible to estimate accurately nearly all new work without making actual tests.

E. F. Miltenberger, vice president and general manager has been largely responsible for revamping and organizing the practice now followed at the plant of the Eastern Steel Castings Co.

Century Electric Co., St. Louis, recently purchased Roth Bros. & Co., Chicago. The latter company will be operated as a division of the Century Electric Co.

Schedule for Census of Manufacturers Planned

With a view to making the forthcoming census of manufactures as responsive as possible to the need of industry for accurate information concerning its own activities, the special advisory committee designated by R. P. Lamont, secretary of commerce, has requested manufacturing organizations, trade associations, and individual manufacturers to offer advice and suggestions as to the form of the schedule to be used in the enumeration.

The subjects covered by the schedule used in the 1927 census are: Description of establishment; character of industry; time in operation; persons engaged; salaries, wages, and materials; products; power; coal consumed. The committee has invited suggestions concerning the form of questions under all of these subjects except production, which will be taken up directly by the bureau of the census with the industrial associations.

COLONEL L. S. HORNER

In view of the fact that it will be necessary to begin the printing of the general schedule early in September, comments on the general schedule should be sent to the secretary of the committee, Thomas W. Howard, 1615 H street, Northwest, Washington, as promptly as possible in order that they may be given consideration. The advisory committee on the census of manufactures appointed by the secretary of commerce includes the following: L. S. Horner, Chairman, Niles-Bement-Pond Co., New York; Charles F. Abbott, American Institute of Steel Construction, Inc., New York; Hugh P. Baker, Chamber of Commerce of the United States, Washington; H. E. Barnard, Indianapolis; LeVerne Beales, bureau of the census, Washington; Christie Benet, National Cottonseed Products association, Columbia, S. C.; M. A. Copeland, federal reserve board, Washington; George G. Crawford, Tennessee Coal, Iron & Railroad Company, Birmingham,; John F. Daly, bureau of the census, Washington; Robert M. Davis, McGraw-Hill Publishing Co., New York; Edmund E. Day, Rockefeller foundation, New York; A. M. Dixon, American Cotton Manufacturers association, Gastonia, N. C.; E. Dana Durand, bureau of foreign and domestic commerce, Washington; J. E. Edgerton, National Association of Manufacturers, New York; Roland P. Falkner, National Industrial Conference board, New York; F. M. Feiker, Associated Business Papers, New York; John P. Frey, American Federation of Labor, Washington; Thomas W. Howard, Chamber of Commerce of the United States, Washington; Virgil Jordan, National Industrial Conference board, New York; John S. Lawrence, Lawrence & Co., Boston; Alonzo E. Taylor, Stanford university, Stanford University, California; Walter S. Tower, Bethlehem Steel Co., Bethlehem, Pa.; E. N. Wentworth, Armour Livestock bureau, Chicago; Clarence M. Woolley, American Radiator Co., New York; Arthur Williams, R. C. Williams & Co., New York; Allan H. Willett, National Coal association, Washington.

Will Hold Exhibit

After a four-year interval the Verein Deutscher Eisengiesserein, Giessereiverband again will hold a foundry trade exhibition in connection with its annual meeting in Duesseldorf from Sept. 4 to 22 after the technical advance work of a chairman committee in co-operation with the Vereins Deutscher Giessereifachleute have been carried out. The exhibit will consist of an instructive exhibition and a firm exhibit. The firm exhibit will include foundries and foundry supply houses. The instructive exhibit will show by contrast of new and old methods systematic reduction of foundry costs. Phases of the foundry industry to be included are: Management economy, foundry plant and machine economy, molding, metallurgy of iron, metallurgy of nonferrous metals, and material divisions.

F. L. Driver Jr., president, Driver-Harris Co., Harrison, N. J., recently sailed for Europe to visit its foreign plants and representatives.

Absorbed Moisture Lowers Core Strength

Although the Moisture Picked Up from the Damp Sand Is Small, It Has a Deleterious Effect on Binder Causing Loss of Strength

By Carl E. Shubert

IT HAS been noticed that if molds containing cores are closed and not poured immediately, the resultant casting or castings must be thrown away because the core *washed* or broke. Furthermore, a mold which is left standing for 10 or 12 hours, if opened just before pouring, shows no apparent physical change in the cores. The touch may reveal a slight dampness which is questionable, especially if the core is removed from the mold for 5 or 10 minutes and then felt for dampness. Still, if the mold is closed and poured the casting is faulty. In an effort to see what caused this loss in strength of cores, a series of laboratory tests were devised and performed to determine whether or not the core absorbed moisture from the damp or moist molding sand.

Use Commercial Oil

Commercial core oil was chosen for the binder because of the popular belief that it does not absorb any moisture. Silica or core sand of approximately 60 mesh was used throughout the tests and ordinary city water.

Tensile test briquets were prepared according to the standard accepted methods of the American Foundrymen's association. The cores were baked in a preheated, gas-fired core oven at a temperature of 450 degrees Fahr. for a period of 45 minutes. All cores or briquets were made from the following mixture: 100 pounds silica sand (dry); 1 pound core oil, and 1 pound water. This provided a ratio of 100 parts of silica sand to one part of core oil and one part of water. The utmost accuracy and painstaking care was exercised at all times in the mixing of the sand, ramming the cores, baking, and in testing to assure accurate results.

Gives Tensile Strength

It was decided to determine the percentage loss in tensile strength, and to determine whether or not the cores absorbed any moisture from the sand. Therefore freshly baked cores were tested for tensile strength immediately upon cooling to room temperature. Other cores or briquets from the same mixture were weighed accurately on an analytical balance to the fourth decimal place and buried in a mold prepared from old or used molding sand. The sand was in direct contact with the briquets. The temperature of the molding sand was ordinary room temperature and its moisture content 10 per cent.

After 24 hours the briquets were removed from the mold and the adhering molding sand carefully taken off. Sharp decreases in their weights were recorded. Tensile tests showed that their average loss in strength was 50 per cent. The loss in weight was thought to be due to the baked linseed oil, the principal ingredient in core oil. The theory was that the linseed oil had undergone some chemical change. It was reasoned that a core made from this mixture is a porous body and some oxygren from the water in the sand and moisture itself was reacting through and with the baked oil to cause the formation of aldehydes, carbon dioxide, and other gaseous compounds which passed into the molding sand and then out into the atmosphere thus causing a reduction in the weight of the briquets which was greater than the weight of moisture absorbed by them. Later this theory was abandoned. The briquets lost in weight because it was practically impossible to remove the adhering molding sand from them without removing some of the sand grains of the core with it, thus reducing the weight.

Devise Another Test

Results of this test showed plainly that a different method of testing had to be devised if any accuracy of results was wanted. The test, however, was partially successful because it was found the tensile strength of the briquets was reduced by contact with moist molding sand to the extent of 50 per cent.

Fresh cores were prepared and baked using the same mixture. A

Table 1

Moisture Absorption Tests on Specimens

	Tensile Strength of the Freshly Baked Briquets—Pounds	Tensile Strength after 24 Hours in Mold—Pounds	Percentage of Loss in Tensile Strength after 24 Hours in Mold	Percentage of Total Moisture Absorbed by Briquets	Percentage of Actual Moisture Absorbed by briquets
No. 1	83.9	42.1	49.8	0.054	0.0154
No. 2	78.7	40.2	48.9	0.050	0.0150
No. 3	73.9	36.1	51.2	0.049	0.0148
No. 4	82.5	41.1	50.2	0.059	0.0159
No. 5	71.9	36.1	49.8	0.052	0.0152
Average	78.3	39.3	50	0.528	0.0152

number of freshly baked cores were tested for tensile strength and the remainder weighed accurately before placing in the mold. The mold, however, was arranged so that the briquets rested on wires in the drag portion, so that the molding sand did not touch them in any manner. The temperature and moisture content of the sand were practically the same as the previous list. There was no venting, and no gate or sprue made. A flat cope served as the upper half of the mold.

At the end of 24 hours one briquet at a time was removed. The mold was closed after each briquet was taken out. The approximate weight of the briquet had to be known in advance so that weights could be added or removed quickly on the balance to determine the weight. The difference in weight of the briquet before it was placed in the mold and after it was removed, was the total moisture absorbed by the core. Speed had to be exercised in weighing because the surface moisture on the briquet evaporated rapidly. When the briquet no longer lost in weight the surface moisture was evaporated. The briquet was weighed again. The difference in weight of the briquet before entering the mold and its weight after the surface moisture evaporated was the weight of the actual or internal moisture absorbed. Results of this test are shown in Table I.

Results confirmed the first test in loss in tensile strength but showed that the briquets apparently did not gain much moisture. The total moisture absorbed averages only 0.0528 per cent. The actual moisture is approximately 3½ times as small averaging only 0.0152 per cent; hardly enough moisture to cause this large decrease in strength. One could add that this small addition of water could be disregarded completely. But, would one be correct? A glance at the sand mixture would show that all weights were in a ratio of 100 parts of silica sand to 1 part each of core oil and water.

This means that if a briquet weighed 93.7028 grams before baking there would be present 93.7028 grams divided by 102 or 0.9187 grams of core oil and 0.9187 grams of water thoroughly mixed so as to have each particle of sand covered completely with oil and water. Upon baking this carefully mixed, rammed, and weighed briquet what would take place at a temperature of 450 degrees Fahr. for 45 minutes? First, 0.9187 grams of water would be driven off completely; second, a certain weight of core oil would be volatilized. The remaining weight of core oil would then be a solid holding or binding the briquet together. Furthermore, each grain of silica would be surrounded completely by a solid film of baked oil, no matter how thin. It would be impossible for the silica sand to absorb moisture.

Silica sand is known to be composed of approximately 98.75 per cent silicon dioxide which does not possess the property of deliquescence. Baked oil is claimed to be porous. Supposing then the silica sand did absorb moisture instead of the baked oil it would have to do this through the baked film structure and by doing so the film would have to be reduced in strength, thus causing the decrease in strength of the briquet. On the other hand, a rough test could be performed to confirm the theory that it is the baked oil which does the absorbing. A small piece of glass was covered with a film of core oil and baked. The baked film placed in water for an hour and it was observed that the film had softened materially.

To determine if the percentage of actual moisture gained by the briquets was small, five briquets were weighed before baking. After cooling to room temperature they again were weighed. This difference in weight represented the loss due to evaporation of the water and gaseous products produced on baking. The weight of the core oil and water in the unbaked briquet was calculated from the mixture. The difference in weight between this calculated amount of core oil and the loss due to evaporation of water and volatilized core oil was the weight of baked core oil in the baked briquet.

Briquets were placed in the prepared mold for 24 hours and then removed. Their actual absorption of moisture was determined and the percentage of moisture gained by the briquets calculated on the theory that it was the baked core oil which absorbed the water and not the whole briquet itself. The results of this test are shown in Table II.

These last results showed the average percentage of moisture absorbed by baked core to be 2.48 per cent, a much larger percentage than it was thought could be true because of the popular belief that baked core oil did not absorb moisture from molding sand. It is true that it is probably the only binder that absorbs comparatively little moisture, but on the other hand, it does absorb it and by so doing loses its strength thus reducing the strength of the cores.

It showed the weight of baked oil in the cores to be much smaller than one would expect. The average weight of the baked oil was found to be only 0.5270 gram. This small amount of material was binding an average of 92.4138 grams of silica sand together. In other words, one part of oil was holding together 175 times its own weight of silica sand to produce an average tensile strength of 78.3 pounds per square inch as the previous test showed. It is quite evident then when a small amount of moisture comes into contact with the core there could be but one result—a decided decrease in strength.

Tests were not run on sand warmer than 75 degrees Fahr., but there is no doubt, in view of the results obtained, that warm molding sand would cause the core to lose its strength more rapidly. Briquets were removed from the mold at the end of one hour and tested for tensile strength. Results indicated that the loss in strength of the cores was a gradual process depending on temperature of the sand

(*Concluded on Page* 764)

Table II

Water Absorbed by Baked Binder

	Weight of Unbaked Briquets, Grams	Weight of Freshly Baked Briquets Room Temperature, Grams	Calculated Wt. of Core Oil and Water, Grams	Difference in Wt. of Briquets, Grams	Wt. of Baked Core Oil in Briquets, Grams	Actual Moisture Gained, Grams	Moisture Absorbed by Oil, Per Cent
No. 1	93.2897	91.9951	1.8292	1.2946	0.5246	0.0129	2.44
No. 2	94.3744	93.0620	1.8504	1.3124	0.5380	0.0138	2.56
No. 3	93.2760	91.9688	1.8288	1.3072	0.5216	0.0124	2.37
No. 4	93.1315	91.8237	1.8260	1.3078	0.5182	0.0120	2.31
No. 5	94.5425	93.2197	1.8556	1.3228	0.5328	0.0144	2.70
Average	93.7028	92.4138	1.8760	1.3304	0.5270	0.0131	2.48

Fig. 1—A Large Force in the Inspection Department Gives Minute Attention to Preventing Any Visible or Hidden Defect in a Finished Casting

New Shop Performs Dual Service

Aluminum Jobbing Foundry, Completely Equipped, Provides Close Control and Yields Valuable Data on Manufacturing

ONE of the most modern and complete foundries of its character to be found in the United States recently has been completed at Fairfield, Conn., by the Aluminum Co. of America. This foundry is, to all practical purposes, a jobbing aluminum casting shop using sand exclusively for molds. In addition to this classification, the foundry might be characterized as a complete chemical and physical laboratory for research purposes along aluminum casting lines. The foundry is successful commercially since during the past year it made castings, some of them running into the thousands, on repetition orders from a great number of customers. More than 250 customers supplied 5000 different patterns for the work which maintains operations at this plant at top production.

S. K. Becker, plant manager who with P. O. Seiser, foundry superintendent, assumed the responsibility for building the plant, had placed at their disposal the facilities of the Aluminum company with practically free rein in the arrangement, details of construction and complete mechanical equipment. The plant comprises a modern and attractive office building, a power plant, pattern storage building and the foundry.

In all of the construction, aluminum alloys have been used wherever it is possible to employ them. Aluminum lighting fixtures, stair rails, doors and practically all building hardware throughout is made of some type of aluminum alloy, even the interior mechanism of the locks, with the exception of the springs, being formed of aluminum. The office interior walls, structural steel roof trusses and frames and many of the machines, furnaces, ovens and other equipment are painted with a liquid, the color pigment of which is aluminum bronze

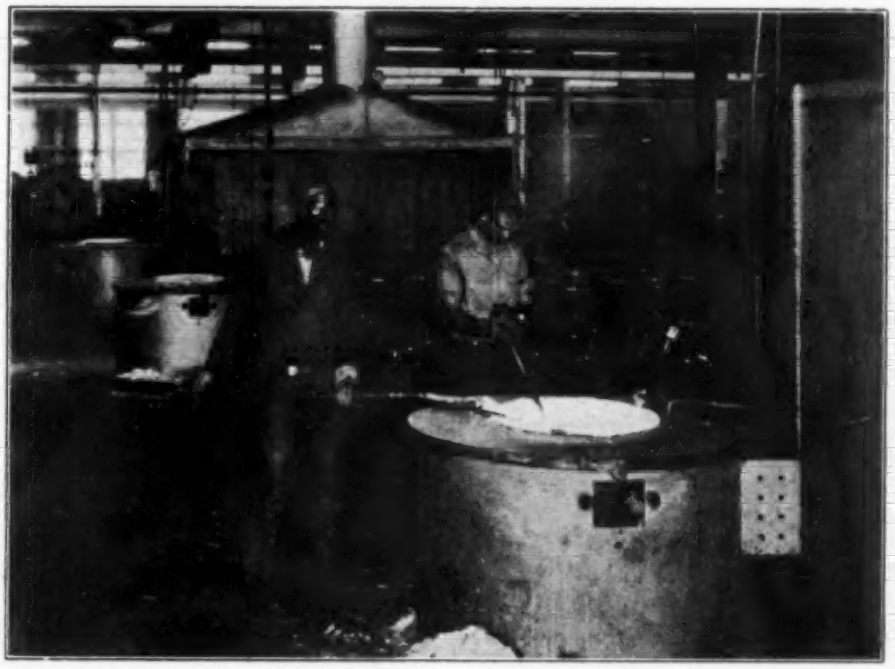


Fig. 2—Three Holding Furnaces Are Provided Adjacent to the Main Molding Floor, Bench and Core Departments

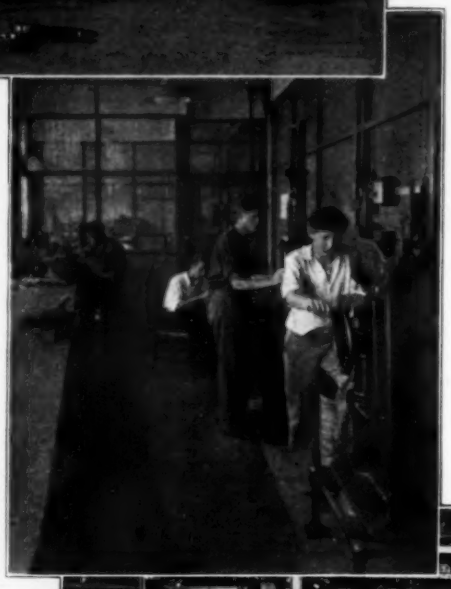


Fig. 3 (Above)—The Floor Molding Department Adjoins the Bench Division and Is Amply Supplied with Handling Facilities. Fig. 4 (Right)—Tensile Test Bars From Each Heat Are Machined to Size and Broken in the Physical Laboratory

powder. All filing equipment, many of the desks and chairs and even the fan blades are made of aluminum.

The foundry has been designed to take advantage of straight line transfer of materials during production. Patterns enter the foundry through the melting department and are distributed on the right to the bench molding department or on the left, to the point where the larger jobs are handled. Immediately adjacent is a completely equipped coreroom.

The melting room, 70 x 190 feet, contains more than 60 oil-fired, pot-type furnaces. In addition one stationary and one rotaing-type, non-crucible furnace is provided for re-melting return scrap and ingot metal for special alloys.

Supervise Temperatures

A pyrometer couple is applied to each furnace. Each pyrometer by electrical connection gives an instant reading in the control room which is situated in a small structure on the inner wall of the furnace room and elevated to such a point that those in charge of melting have each furnace in full sight at all times. In addition to the direct reading pyrometer apparatus which may be cut in on any furnace at will, continuous recording type pyrometers give a constant record of the time and temperature history of each melt in the refining furnace. Care is taken to assure that no charge will become overheated and when the proper temperature is reached, a signal is flashed from the control room which notifies the pouring gang that the furnace should be tapped at once.

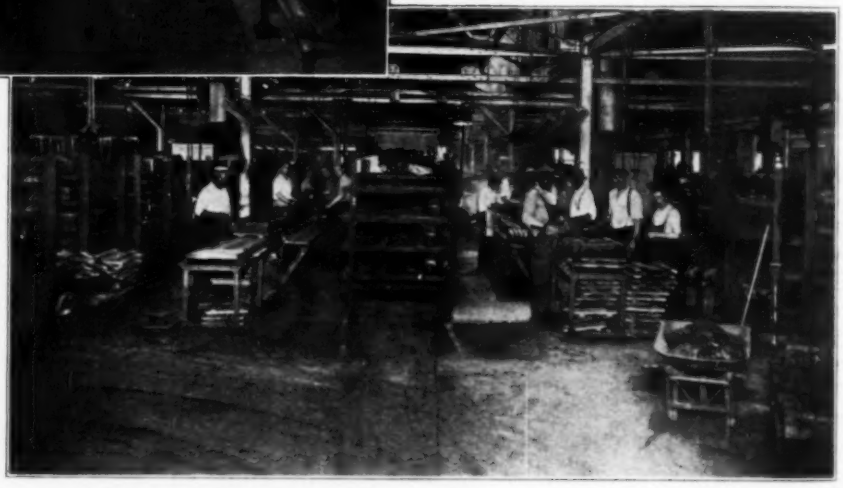
floor adjacent to the core department permit the maintenance of the metal at a fixed temperature until the molds are ready.

Only new metal, or that which has been refined in the company's own furnaces, is used in making castings in this plant. No outside scrap is employed.

Unit Floors

The bench molding floor immediately at the right on entering the foundry from the melting room, is 60 x 150 feet. The bench floor is divided from the adjacent departments by low concrete walls and each individual floor, employing two squeezer type molding machines, is separated from its neighbor by a low bench on which are placed necessary cores, chaplets and sundries needed in the work. Twenty-four molding machines are employed in the bench molding department.

Fig. 5 (Below)—The Core Department Is Ample To Care for Miscellaneous Core Demands and Also To Make Complete Dry Sand Molds for Castings



The special alloy iron pots used in the oil-fired melting furnaces are coated with lime before each heat, while all iron ladles and ingot molds are given a similar protection against the chance of any contamination of the aluminum by iron. Pouring ladles are preheated over open flames and graphite crucibles used in pouring the bench floor work similarly are brought to a high heat before receiving the charge of metal.

When a furnace is tapped, the metal is conveyed to one of a number of pyrometer stations, the metal is skimmed and the temperature is permitted to drop to the exact point predetermined by the melter. For the larger castings, or those which may require some delay in pouring, three resistance type electrical furnaces on the foundry

Facing sand is mixed in a mill room adjacent to the foundry floor and is delivered to each molding station. Backing sand similarly is supplied. After the molds are shaken out, the sand is put through a rotary treating and revivifying machine and properly tempered for the succeeding task. Perforated steel bottom plates are used.

Paralleling the bench molding department is the floor molding department liberally supplied with crane facilities for heavy lifts.

Practically all of the molds in both the bench and floor molding departments are poured through runners in which strainer cores are set. These strainer cores have for their purposes breaking up the stream of metal to permit a certain elapsed time between

Fig. 6—The Heat Treating Department at Present Operates Only One Furnace With a Quenching Tank Adjacent

the start and finish of the entry of the metal into the molds.

The core department is situated across the end of both molding floors. This department supplies the cores used in the floor and bench work and also gives facilities for making molds for special types of castings which must be poured in dry sand. Nine core ovens, one being of the drawer type for smaller cores, provide baking facilities for the entire plant. Each of these ovens is equipped with oil burners which use about two and one-half gallons per hour. The firing period is one and one-quarter hours and cores are permitted to stand two and one-quarter hours in the ovens before removal. The temperature, which is controlled by recording type pyrometers, ranges from 280 to 440 degrees Fahr.

Cleaned and Inspected

When castings emerge from the molding and core departments, they are conveyed immediately to the trimming room which is supplied with bandsaws, electric chippers, grinding wheels and electrically operated filing and trimming machines and sand-blasts. Each casting is cleaned and thoroughly finished before final inspection. It then is conveyed to the inspection department where it is subjected to a number of tests including visual inspection, measurement to jigs and fixtures, pressure and hydraulic tests. On those classes of castings where defects may be corrected, defectives are returned to the trimming room for welding. Large castings are preheated before welding. Certain work which the company is making for the navy department, for airplane manufacturers and for automotive service does not permit this form of reclamation.

Castings which require heat treatment are sorted in the inspection room and placed in metal baskets. They are transferred by monorail crane to the heat treating room where one electric furnace or oven now is installed and another soon will be placed. The heat treatment varies from normalizing for a period of two and one-half hours at 350 degrees to the more extended treatment involving 18 hours at 900 degrees followed by quenching in water. The quench-

Fig. 7 (Left)—The Bench Floor Is Divided Into Individual Units Fig. 8 (Above)—More Than Sixty Furnaces Supply a Melting Capacity of 1,500,000 Pounds a Month

Fig. 9—Certain Castings Required to Meet Severe Service Requirements Are Given Individual X-Ray Inspection for Hidden Defects

ing tank, with automatically operated covering doors is placed directly in front of the heat treating ovens. A few castings for special service are given a steel ageing treatment varying from 2 to 45 hours under steam pressure of 75 pounds.

Minute technical supervision is exercised at all points in production. The care in controlling melting conditions has been mentioned. A complete physical and chemical laboratory permits supervision on all points in operation. A test bar is pulled from each heat from each furnace, check analyses are made on each job. In addition the company has supplied one of the most complete X-ray and micrographic laboratories. The X-ray room is adjacent to the physical laboratory. It is constructed of sheet lead throughout and equipped with every device to assure the safety of operators. All castings destined for severe service conditions are given an X-ray inspection. A case in point is the cylinder head for a 9-cylinder rotary type airplane engine where even the most minute flaw or blowhole is sufficient cause for rejection.

This casting is typical in many ways of the care exercised at various points in manufacture. It embodies a cylinder head and intake and exhaust ports all provided with deep thin vanes set at right angles to the surface. It was found that this job could be handled more effectively in dry sand. Furthermore, the foundry decided that the dry sand mixture could be aided by an entire absence of water in the sand mixture employed. Accordingly dryers were built in the sand mixing room and all sand is dried at the rate of two tons an hour in these special dryers provided for the purpose.

The sand then is mixed in paddle type mixers in the proportion of 192 quarts of sand to six quarts of boiled linseed oil. This mixture is almost unbelievably dry, but takes a sharp impression of the thin cooling fins in the mold, bakes to comparative hardness and when the metal is poured, quickly disintegrates to relieve strain. The mold is made in two parts, divided between the inlet and exhaust ports. The cope half and drag half each are supplied liberally with wires, more than 175 being required in each mold. Thin long finishing nails provide a more economical form of core wire than would be possible by cutting straight wire to size. The molds are made on squeezer type machines, are baked and then delivered to gravity-type, roller conveyors. The cope half is assembled on one side and the drag half on the other converging at the lower end for closing when the molds are set on edge and poured through the end.

Held to Temperature

Metal for these castings is brought from the melting department to the holding furnaces previously mentioned and when a number of molds are assembled they are poured. The time of pouring is marked on each mold and the castings are permitted to stand for two hours before they are stripped. The mold and cores disintegrate to powder on stripping.

The castings then are taken to the saws where the risers are removed. They next are ground and taken to the filing bench where mechanical trimmers similar to dentists' drills are employed to give a perfect finish.

They then are sandblasted, taken to the inspection room, submitted to hydraulic test and conveyed to the X-ray laboratory. Here each casting is inspected in minute detail for any

(*Concluded on Page* 760)

Fig. 10—Saws, Pneumatic Cutters, Grinding Wheels, Mechanical Files and Trimmers and Sandblast Provide Mechanical Aid in Finishing Castings

Producing Steel Castings in the Modern Foundry

Part VII

By Charles W. Veach

IN SOME foundries, particularly those equipped for straight line production, a separate department is maintained to take care of the pouring floor. This department has charge of the teeming of heats, care of the ladles, and sees that the molds are properly spotted, poured, and shaken out or transported to the shakeout room. It also must clean the pits after each heat is tapped and must keep the room in order and in proper condition to take care of the heats when they are ready.

Co-operation is extremely necessary between the melters making the heats, the head of the molding department and the man in charge of the pits or pouring floor. The molding department must keep in closer touch with the pouring department than the melter. The latter only occasionally is required to inform the ladleman of the condition of a heat so he can speed up pouring in case the metal is dull or low in carbon.

Can Judge Conditions

Some ladlemen seldom need to be warned that a heat is dull, for, when they first start pouring, they can judge the temperature condition quite accurately. However, a word of warning may prevent the loss of several hundred pounds of steel at the finish of pouring. The molder foreman, on the other hand, must keep in close touch with the foreman of the pouring floor for he wants a certain number of each kind of molds poured in each heat so that he can keep his molders supplied with flasks. Furthermore, when newly designed castings are made, the molder foreman is better qualified than anyone else to determine pouring conditions.

Whether or not it is advantageous to have a separate department to take care of the pouring floor, depends on conditions in each plant. Most important factors in this respect are layout and size. If the shop is small and the molding is done in the same room in which molds are poured and shaken out, the molder foreman or one of his assistants may be responsible for the work which, in a large plant, would require the whole time of one man. Even in some large foundries, the molder foreman has supervision over the ladle gang because molding, pouring, shaking out and reconditioning the sand all are done in one large room. Considerable supervision is required where all molds are made in a room some distance away from where they are poured and must be transported to the pouring floor, spotted in rows for pouring, poured and then removed to the shakeout.

One of the most important duties of the pouring floor foreman is the care of ladles. Trouble and loss will be avoided if the condition of the ladle linings, the way the nozzle is put in, the method of making up the stopper, and the way the stopper is set when getting a ladle ready to receive a heat, are correct. Other duties of the pouring floor foreman include the selection of ganister, clay, brick, utilization of fireclay brick bats as grog, and ordering loam when that material is used. He also must decide on the mixture of the various materials used to form the mud for protecting the brick lining if such protection is used. Supervision of the setting of nozzles, putting bottoms in ladles, and deciding the thickness of the mud lining to be applied come under his jurisdiction.

He also is responsible for the correct preheating of the ladles preparatory to receiving the metal. This includes the building of the slag runner or overflow to suit the size of the heat. He also must see that provision is made to suit newly lined ladles or those having thin linings. Spotting the ladle at the furnace after the stopper has been properly set; seeing that pouring is properly started; supervising the pouring of physical and chemical tests; reporting molds poured to the molder foreman and making a report to the melter if heat is abnormal are included in his job.

Directs Shaking Out

He also must dispose of the molds which have been poured, seeing that they either are shaken out at some convenient place near where they were poured or transported to the shakeout if a separate room is provided for the purpose. If the molds are shaken out in the same room where they were poured, the man in charge of pouring must see that the flasks are placed where the molders can get them without too much effort.

One of the pouring foreman's chief duties is keeping the pouring floor clean and orderly. Where molds are to be spotted, the floor must be kept level. It is important that the bottom of the flask has equal bearing at all points so that the molds will be level when poured. Cleaning the pits at the furnaces after each heat also is important both from an economic point of view and for safety. This

Explains Duties

PROPER care of the ladle equipment and the handling of heats are among the most important items to be considered in the production of sound castings. Duties of the pouring floor foreman are many and important and must be thoroughly understood if smooth operating conditions are desired. Pouring practice, instruction of ladle cranemen, care and upkeep of ladles, and ladle linings all are important factors in the production of high quality work. These points are given consideration in this article which is the seventh of a series on the production of steel castings in the modern foundry.

might be viewed from the standpoint of appearance. A shop that is kept clean has a prosperous look.

Another important phase of the responsibility resting on the shoulders of the pouring foreman is the selection, inspection and grading of stopper heads and sleeve tile. Making up the stoppers is important work. The best tile are placed next to the end having the graphite stopper attached. Those having slight defects are placed at the top where there is no danger of slag or metal cutting through them. A defective stopper head or sleeve tile may be the cause of losing part of a heat.

Selecting nozzle brick is another important duty of the pouring foreman. However, since the committee functioning under the auspices of the American Foundrymen's association standardized nozzles for use in steel foundries some ten years ago, this work has been simplified. Careful inspection and testing of each nozzle of a shipment when received still is not to be neglected.

Nozzles are inspected to disclose flaws, and to sort out any that may have a misshaped bell. For the latter purpose, a stopper which is known to be true is tried in the bell. If it holds hot sand without leaking and is perfect in all other respects, it is placed in stock to be drawn out later and, after being inspected again, is used. Nozzles must be stored in a warm, dry place.

Pouring practice constitutes one of the most important phases of steel foundry work. If the metal is not handled properly by the pouring gang, many defects may appear in the castings which cannot be charged properly either to the melting or molding departments.

Must Be Experienced

Runner cups used in pouring steel castings generally are not over five inches in diameter. Importance of hitting the cup's center without loss of time easily is seen when more than a hundred molds must be poured with one heat. If the craneman is inexperienced and jiggles around the cup at each move, the metal will become too cold to pour properly and a loss will be sustained. An expert ladle-craneman is a valuable employe in a steel foundry.

An indifferent or inexperienced ladle-craneman and a sloppy ladleman make a bad combination. They can cause an unaccountable loss of metal and one which never may be recovered. That refers to the shower of sparks, and pellets of metal which occurs when the nozzle is opened before it is centered over the runner cup. This is an avoidable waste if the craneman has skill. The pouring floor foreman must teach ladlemen to see that the nozzle is directly over the runner cup before opening up, and to shut off as soon as the metal rises in the sinkhead. The foreman has several factors to consider while endeavoring to train those men to pour without wasting metal. Ladlemen must not permit too much time to be lost while waiting for the nozzle to be spotted over the runner cup, for a greater loss may be sustained by the metal becoming dull and causing misruns or part of the heat may have to be sacrificed. Shutting off without touching up after the metal shows at the highest point of the mold may result in a hollow casting due to the metal settling back. This is not to be thought of as a shrinkage cavity, but is a pouring defect. Fast pouring will produce it in many designs of castings unless the stream is shut off when the mold is full and the casting touched up.

Gives Pouring Practice

Strains result from pouring too fast particularly when the mold is filled well and the risers are small. A good method of pouring is to open up *gradually*, then pour as *rapidly* as desired until the mold is about filled, then ease up and pour as *lightly* as the heat will stand and touch up before leaving the mold.

It has been said that the first requisition for satisfactory ladle practice is the selection of the right quality of brick for lining the ladles. The second is the way the ladle is lined. In the selection of brick for ladle linings it has been found that two kinds are required. A *stiff* mud brick is best for the bottom. A good grade of fire clay brick is required for the sides. Both must have a minimum amount of expansion when heated and must not shrink appreciably on cooling.

When a ladle is lined, the shell is covered inside with a layer of stiff fireclay sufficient to cover all rivet heads and make a smooth surface on which to lay the first course of brick. This course covers the sides of the shell, starting at the bottom and reaching to the top. The lower half may be 2-inch, split brick laid flat, then decreased to 1-inch splits if the shape of the shell demands that it have an even surface. Next the stiff mud brick, which are straight 9-inch square brick, may be laid in *row-lock* fashion to form the bottom. These engage the splits already in place on the sides. The second course of the lining rests on the brick forming the bottom. To break joints the first course is laid flat then continued row-lock. The top course may be laid flat, thus giving more room in the ladle.

The brick are laid without mortar. They are dipped only in a thin grout. This makes close joints and the brick wear better than if stiff mortar is used. A lining lasts anywhere from 12 to 150 heats depending on the size of the heats, on the condition of the slags, and on whether or not mud or ganister linings are used to protect the brick lining. Many steel foundries use mud linings, but some do not.

The subject of mud linings recently was presented for discussion before the committee of open-hearth superintendents at one of their meetings. Questions were asked to determine whether or not a mud lining would contaminate the metal with particles of its material. Those using mud linings argued that if the practice was used intelligently, none of the material would become lodged in the casting. It was the consensus of opinion that the practice was economical.

Capacity of the ladle should be two or three tons more than the average heat charged. This is required to take care of *pigged* heats. It is important that the overflow at the top of the ladle be built up or cut down so that the body of slag on each heat shall be uniform. A newly lined ladle probably will be filled with a normal heat. When the lining is half gone the slag line will be much lower. It can be seen that the capacity changes with each succeeding heat becoming greatest when the lining gets so thin that it must be renewed. These changes occur during the time that 12 to 20 heats are poured from the ladle if no mud is used to protect the brick. Unless the slag line is watched closely, more slag will be carried after a few days than was carried when the ladle first was lined.

May Increase Mud Lining

When a mud lining is used, the ladle runs over a hundred heats before it becomes necessary to renew the brick lining. Furthermore, when the brick lining has become worn, the thickness of the mud lining may be increased so that over a period of more than a hundred heats the capacity of the ladle does not change materially. This helps the melter to run off all excess slag only retaining enough to prevent any undue loss of temperature. A serviceable mud for lining ladles can be made by mixing fireclay, two parts; common loam, two parts; grog, ground brick bats, one part; backing sand, one part. Mix to a stiff mud and apply with a

trowel to obtain the thickness desired on the walls.

If the ladle has been preheated to about 2100 degrees Fahr., it will lose considerable of its temperature while the stopper is being set, and during the time the taphole is being opened. When the metal starts to flow, it is hardly red hot. However, all preliminary drying has taken place, and the cooling effect it has on the heat will not be sufficient to cause any pouring difficulty. The temperature contrast between the ladle lining and the metal flowing into it, is not great enough to cause a reaction at the surface of the lining.

If the ladle is not preheated, the hot metal may react with the cold surface and also a large amount of heat will be extracted from the metal by the ladle lining. That loss of heat must be provided for prior to the tapping of the heat, that is, the heat must be made hotter when the ladle is not preheated than when it is. Ordinarily a preheated ladle will lower the temperature of the metal about 100 degrees Fahr. before the temperature is equalized.

Reviews Heat Treatment of Cast Iron

By F. B. Coyle

SINCE the intrinsic value of alloy steel is realized only through heat treatment, it is reasonable to assume that cast iron, which is essentially a steel whose continuity is broken by free graphite, in general should be amenable to heat treatment processes.

Even a brief survey of some of the literature on cast iron demonstrates that not only has considerable time and effort been devoted to the study of the heat treatment of cast iron, but that the subject is an extremely broad and complicated one for study. A survey conducted by committee A-3 on cast iron of the American Society for Testing Materials has shown that there is sufficient interest among the various industries to warrant a systematic study of the possibilities of heat treatment of that metal.

Consider Factors

There are four important factors to be considered in subjecting cast iron to heat, which are fully recognized among the industries. These are:

Artificial Aging—This means the heating of the casting to relatively elevated temperatures to relieve the internal stresses set up during cooling because of variations in contour and thickness. Heating also prevents distortion of the casting after machining or during subsequent service.

Alteration of Chemical and Physical Properties—By annealing at temperatures above the critical range, it is possible to reduce hardness considerably and thereby increase machinability.

Growth—It is well known that most grades of cast iron increase in size permanently when subjected to elevated temperatures. This is a serious problem in many instances, and the elimination of growth will greatly increase the applicability of cast iron.

Rust Proofing—The process of parkerizing, galvanizing and tinning have been applied to gray iron castings for rust proofing purposes. All of these processes involve elevated temperatures and some give rise to considerable difficulties.

While these factors illustrate the importance of the subject under consideration, the following brief analysis will give a general conception of the broad scope and extended possibilities of this field of study. The subject can conveniently be divided into three fields according to temperature range, as follows:

1. Up to 800 degrees Fahr.—no change in structure or physical properties occurs.
2. From 800 degrees Fahr. to the critical range—a change in a structure occurs, but no change in physical properties.
3. From the critical range to the melting point—both structure and physical properties change.

Permanent increase in size is effected when cast iron is subjected to certain types of carbonaceous gases at temperatures up to 800 degrees Fahr. Such gases penetrate the metal and through a process of cracking deposit free carbon. A slight relief of casting stresses is effected when castings are subjected to temperatures slightly under 800 degrees Fahr. for long periods of time. Some investigators have found that when cast iron is exposed to some gases at temperatures slightly below 800 degrees Fahr. the strength is materially diminished. In general, however, cast iron maintains its strength uniformly up to 800 degrees Fahr.

Graphite Precipitates

Several investigators have shown definitely that the cementite of pearlite decomposes with the accompanying precipitation of graphite from 800 degress Fahr. to the critical range. It has also been shown that complete malleabilization has been produced within this temperature range on a laboratory scale. It is known that the alloying elements nickel and chromium inhibit this change in structure, but the published data are meager. Further work is required to demonstrate the exact effect of these and the effect of other alloying elements on this particular change.

Artificial aging can be effected completely within the previously mentioned temperature range. However, since the graphitization which also occurs reduces both hardness and strength, it is advisable to restrict the aging treatment to temperatures below 950 degrees Fahr. Within the temperature range of 800 degrees Fahr. to the critical range, growth is initiated by graphitization which also produces incipient cracking. In the presence of oxidizing gases growth is aggravated by the gases penetrating along graphite flakes and oxidizing silicon to silica. Carbonaceous gases also enter the metal through the graphite flakes and by cracking deposit more graphite and further fissuring results until the metal is finally affected throughout its entire structure.

Factors Govern

MANY investigators have spent considerable time studying various phases in connection with the heat treatment of cast iron. This article, abstracted from a paper presented at the 1929 convention of the American Society for Testing Materials at Atlantic City, N. J., outlines four important factors to be considered in subjecting cast iron to heat treatment. The author is research metallurgist, International Nickel Co., Bayonne, N. J.

The change in physical structure of the metallic ground mass which occurs from the critical range to the melting point, is similar to that which occurs in steel.

Within the lower portion of that temperature range the change in structure of gray iron is identical with that which occurs below the critical range. However, as the temperature increases this change is diminished due to the power of the metal to redissolve carbon as the temperature increases. Of course the exact mechanism of the change in structure depends upon the initial structure of the metal. An iron which is initially white can be graphitized completely (malleabilized) if free of alloying elements, or only partially graphitized if alloying elements are present. The range of physical properties obtainable in this manner is considerable.

Annealing at temperatures slightly above the critical range reduces hardness and increases machineability by decreasing combined carbon. However, strength also is diminished and iron subjected to such treatment is extremely weak.

Growth occurs within the temperature range from the critical range to the melting point in the same manner as described for the range from 800 degrees Fahr. to the critical point, but is aggravated and accomplished more rapidly. The use of alloying elements shows promise of reducing or eliminating such growth, but considerable investigation yet remains.

Carburizing followed by subsequent hardening has actually been resorted to for developing hard wearing surfaces for special applications. Quenching has been carried out in several instances to accomplish the same purpose as carburizing. Quenching and drawing in so far as published data indicate, shows little promise when applied to plain cast iron, but its usefulness may be possible with alloy cast iron. This treatment has been demonstrated to effect an increase in strength of 50 per cent or more when applied to low-carbon iron or high-strength cast iron.

Molding Sand Merits More Study

By R. H. Palmer

MOLDING sand possesses qualities which enable it to be manipulated and formed to definite shapes which it will retain when molten metal is poured in it. It has the requisite chemical composition to enable it to resist fusion while the mold is filling with metal. Also the molten metal will not cause it to scab or otherwise injure the surface of the mold. The sand may be retempered and used again.

Porosity and permeability often are confounded. Porosity means full of pores. Permeability allowing passage. Thus permeability allows passage of gases through the pores of the sand.

Molding sand is found in large deposits in New York, New Jersey, Ohio, Indiana, Connecticut, Massachusetts, and other states. The characteristics of molding sand vary. Combinations or mixtures of sand from one locality with those from another, often will give a desired grade.

Thus in producing light and medium castings, coarser grained sand often is mixed with the smaller grained sand to *open it up*, to use a molder's term. In this way larger sized pores in the sand insure greater permeability. Often when a sand does not withstand the heat of molten metal, the addition of another sand higher in silica proves advantageous.

Silica is not to be confused with silicon. Silica is known to the chemist as an acid. Thus in the acid process, in the steel furnace, the lining generally used is silica sand, for the bottom. This is sintered, or baked by heat and fused, while the sides are built of firebrick. The value of the brick lies largely in the silica content. Silicon is one of the elements of pig iron.

The principal requirements of molding sand are: Bond, permeability, porosity, and resistance to fusion.

An excess of lime—1.00 per cent or more—will lower the power of sand to resist fusion. If present as a silicate it will combine with silica and alumina of the sand under the influence of the heat of the molten iron, and will vitrify and form a scale on the casting.

In stove plate foundries *runners* or *rat tails* sometimes appear on castings, especially on covers or plain surfaces. In such cases the molders usually sift a small portion of air slaked lime over the sand heaps and this disposes of the trouble.

The sand also must have bond, or cohesion. Air fills the pores in the mold. When heated during the pouring of the metal this air expands. The sand must have sufficient bond to resist the pressure due to this expansion, and it must have sufficient permeability to permit the escape of the contained air and of gases generated in pouring.

Finer-grained sands, even when they are approximately the same size, have a greater pore space than the coarser sands when both are equally tempered. According to one investigator the average pore space of seven samples of No. 100 quartz sand was 36.6 per cent while that of a sample of No. 20 sand was 33.9 per cent. This same experiment shows that sharp, angular sands have a greater pore space than rounded sands of the same size, indicating apparently the greater difficulty of making angular grains pack well. It was found also that the smallest pore space was obtained when two sands of rounded grains, but of quite dissimilar diameters, were mixed in about equal proportions by weight.

Chemical analysis, while determining the amount of bond in the sand, and also its resistance to fusion, does not determine whether or not a good casting can be produced with any given sand. Microscopic tests are necessary to reveal the shape of the sand grains. A sharp angular grain is of the utmost importance, since with this grain the sand can be rammed firmly around the pattern, yet give a porous and permeable mold. A molding sand with grains nearly rounded, makes a good mold but requires more attention.

On heavy castings the sand must withstand a high degree of heat for a considerable period. To resist fusion, a sand containing a maximum silica content and a minimum bond is required. The refractoriness of the sand depends on its silica content, but the bond decreases as the silica increases. Ground silica rock, or fire sand is added sometimes to *open up* the sand.

Since the introduction of molding machines, it has been found that less venting is required in molds whether jarred, squeezed or rammed with a machine that throws the sand with great force. These leave the pore space in the rammed sand nearer its natural condition and allow greater permeability than when hand rammed.

Cleans Automobile Castings Quickly

By Pat Dwyer

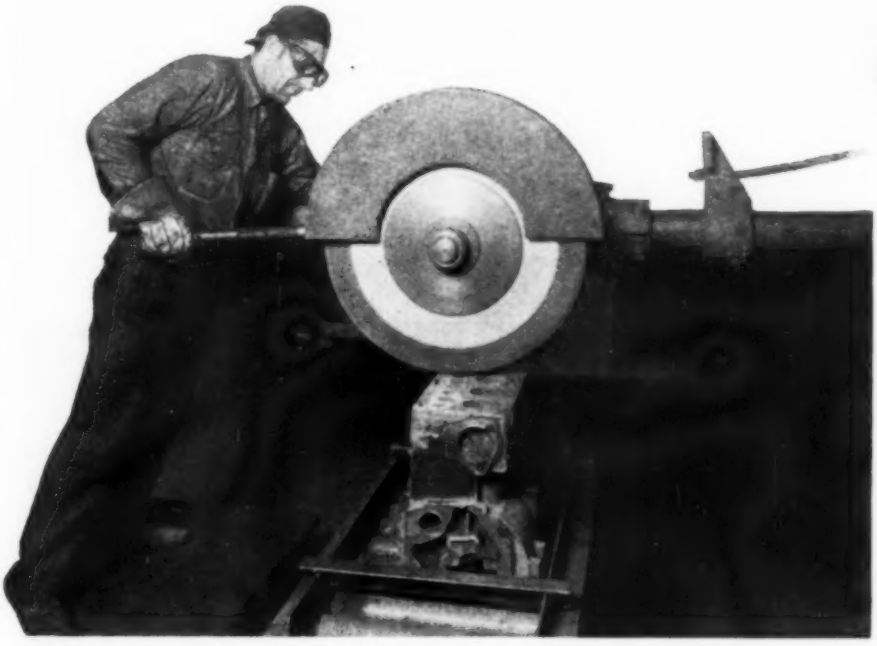


Fig. 1—The Cylinder Block is Held in Place Temporarily by an Angle Iron Frame on the Roller Conveyor

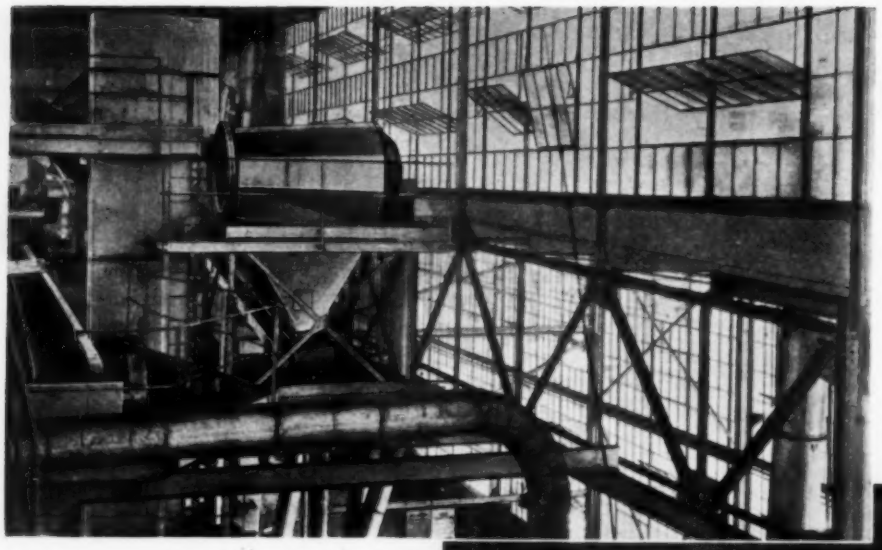
REALIZING the truth and wisdom of the sterling old adage "An ounce of prevention is worth a pound of cure," the Oakland Motor Car Co., in its new foundry at Pontiac, Mich., begins cleaning its castings before the castings actually come into existence. Which simply is another way of saying that the sand from which the molds are composed is selected and prepared in a manner that causes it to fall readily from the face of the castings before and during the shaking out process.

Control of the sand centers in a well equipped laboratory where daily samples are tested for bond, permeability and moisture content. Actual preparation and distribution of the molding sand is carried on through two main mechanical systems that practically eliminate the variable human factor.

Facing sand containing old sand 6 parts, new sand 3 parts and coal dust one part is prepared at the rate of 60 tons per hour in a two-unit installation made by the National Engineering Co., Chicago, and located close to the sand storage building referred to in the first of this series of articles. Auxiliary equipment above each of the 8-foot diameter pans includes a storage hopper for old sand, a storage hopper for new sand, a closed vessel for the sea coal and a water tank to supply the added water.

The sand hoppers are filled by a grab bucket suspended from the crane which operates over the extensive series of concrete sand storage bins. The coal dust receiver is filled by air pressure from a small coal pulverizer unit and the water tank is connected to the water supply line. Each of these units is provided with a measuring device which deposits the correct amount of each ingredient to form a batch in the pan where they are incorporated in a homogenous mixture by the action of a pair of balanced rollers. Each batch is mulled for a definite period of 7 minutes and then discharged into the

Fig. 2 (Left)—A Small Air Hoist Lifts the Cylinder Block From the Conveyor Hook After It has Passed Through the Sandblast Chamber. Fig. 3 (Right)—Cylinder Blocks Are Tumbled After They Have Been Sandblasted



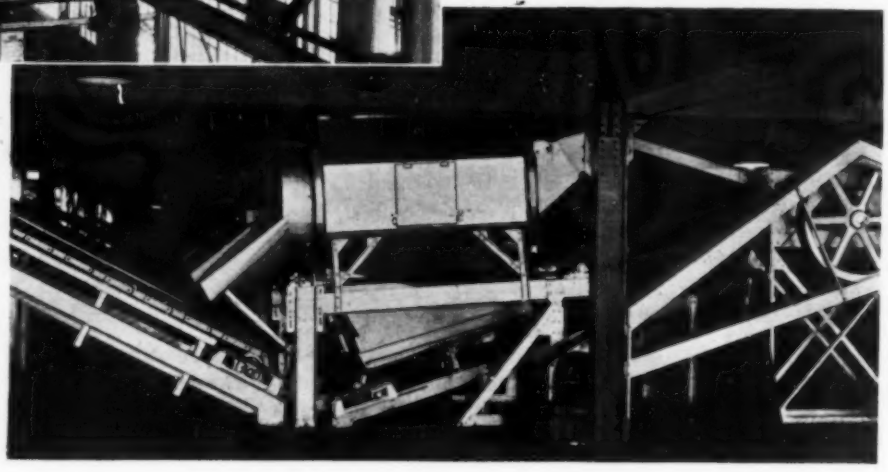


Fig. 4 (Above)—Upper Part of One of the Three Plants in Which the Sand Is Prepared for Use. Fig. 5 (Right)—Castings Fall Through the Floor into a Series of Tumbling Barrels and Then Are Discharged on to an Inclined Elevator Which Delivers Them to the Rolling Conveyors

boot of an elevator which conveys it to a large storage tank from which it is distributed later by dump truck.

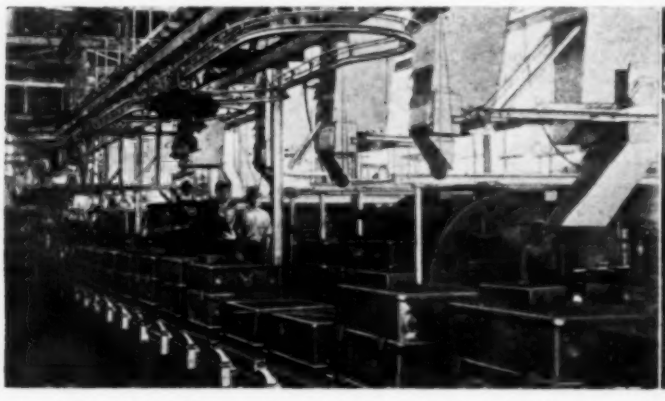
Molding sand is collected, prepared and distributed continuously through an extensive sand handling system installed in the foundry by the Link-Belt Co., Chicago. The system includes seven molding lines and conveyors and three independent sand preparation units. One of the sand handling units serves the two conveyors where cylinder blocks and cylinder head castings are made, one supplies sand for flywheels and transmissions and the third takes care of the three remaining molding units. In addition to the sand handling equipment, the Link-Belt Co., also designed and installed all the conveying equipment for the molds and castings up to the point where the castings are taken on the overhead cooling conveyor system installed by the Palmer-Bee Co., Detroit.

Cylinder block molds are made on a battery of ten molding machines, five for the cope and five for the drag, supplied by the Osborn Mfg. Co., Cleveland. Facing and backing sand fall into the flask from twin overhead hoppers equipped with control gates. The drag molds are set on a sliding conveyor which carries them through the various zones, coring, inspection, closing, and pouring. After they have been poured, the molds travel around an 180 degree turn on a roller conveyor and then slide on rails through the cooling area under a hood. During this stage of the journey they are propelled by pusher dogs attached to a roller chain.

Approximately half way on the journey the cope is removed and shaken out in a vibrator bail made by the Stoney Foundry Engineering & Equipment Co., Cleveland. The cope flask is returned on a roller conveyor to the molding station. The sand falls through a grating on to an underground reciprocating conveyor which returns it to the circulating system. Clean-up, strike-off and all sand spilled in the vicinity of the machines falls through a floor grating on to the same conveyor.

The drag half of the mold with the casting still in place travels on to a point near the end of the unit where the casting is removed with a tongs attached to an air hoist and hung on an overhead trolley type cooling conveyor which carries the casting to the core knockout building and thence to the cleaning room.

The drag then is vibrated to remove the sand and afterward is returned on a roller conveyor to the drag molding station. The sand falls through a grating in the floor into a



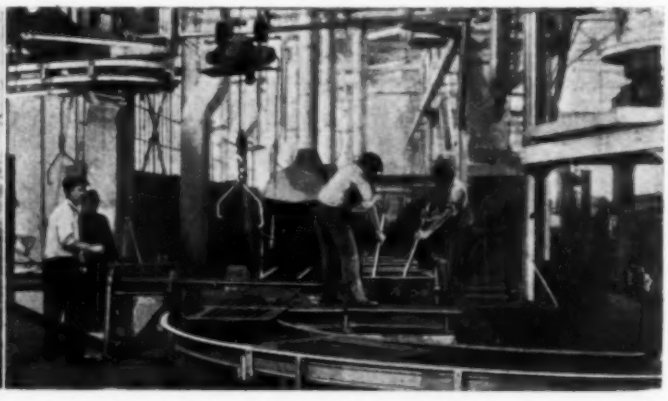


Fig. 6 (Left)—Monorail Hoists Facilitate the Work on the Cylinder Mo'ding Unit. Fig. 7 (Right)—Drags on the Cylinder Mold Line Are Shaken Out at the North End of the Conveyor

receiving bin from which it is taken by a bucket elevator to a revolving, horizontal, tapered, hexagonal screen which discharges refuse to a box on the floor. The sand goes to a retempering conveyor, then to a twin-paddle pug mill from which it is discharged into one of the three 100-ton capacity storage tanks.

Sand is drawn from this tank on a revolving plate feeder, elevated and delivered to a final tempering belt, which in turn discharges to a squirrel cage aerator, and then is distributed to the flight conveyors for delivery to the hoppers above the molding machines in the seven molding lines.

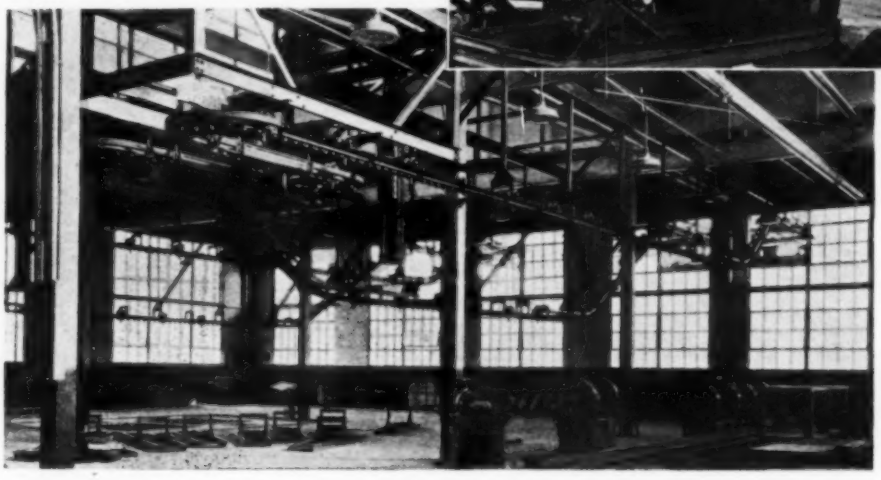


Fig. 8 (Above)—Sand, Rods, Pipes and Rubbish Are Segregated in the Lower Part of a Two-Story Building at the End of the Aerial Conveyor Line. Fig. 9 (Left)—Castings Conveyors Enter the Cleaning Room Through Openings in the Windows at the South End

Facing sand is carried in dump trucks from the room where it is prepared as described in a former article in this series. It is dumped into hoppers in the floor, then elevated and delivered to the same flight conveyor which carries the heap sand. The conveyor is divided into two compartments and thus is in a position to handle backing sand and facing sand simultaneously.

Cylinder heads, flywheels, transmission cases, manifolds, etc., are made on five molding lines. The conveyors are of a new type developed by the Link-Belt Co., in which it is claimed friction is reduced to a minimum on power-driven roller trays. Molds and sand are handled in a manner similar to that described for the cylinder blocks, except that at the shakeout, both castings and sand are discharged through openings in the floor. Apron conveyors deliver the castings to large tumblers in the basement where the sand is removed from the castings and returned to the circulating system. The castings are taken up on inclined apron conveyors to the cooling conveyor system outside the building. The castings are discharged over the ends of the apron conveyors into steel pockets which automatically discharge them into steel baskets suspended from the cooling conveyor. The steel baskets pass at a given speed in front of the apron conveyors and naturally cannot be made to synchronize with the more or less intermittent arrival of the castings. The steel pocket in front of each apron conveyor supplies the necessary elastic link. The castings accumulate in the pocket until the basket is passing. Then they are dumped.

Molds for the smaller castings are shaken out at two points on each of the mold conveyors. The copes are lifted at a point midway from the

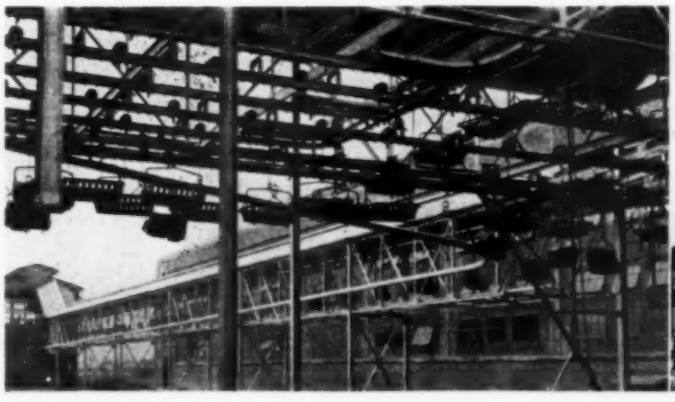


Fig. 10 (Left)—Cores Are Removed From the Cylinder Blocks in the Building Shown in the Background. Fig. 11 (Right)—Castings Are Discharged Over the Ends of the Inclined Conveyors and Then Are Picked Up By the Aerial Conveyors

two ends while the drag and casting are dumped at the north end, or the end farthest from the pouring station. The small flasks are flipped over by hand, in some instances by one man and in others by two. The larger flasks are handled with an air hoist.

Copes from flywheel molds are lifted by a long, forked lever handled by one man. The lever is suspended from a point near the forked end, thus giving the man all the advantage when he applies the fork to the handles of the flask and bears down on the single end. While resting on a roller conveyor near the mold conveyor, the cope is brought into contact with a vibrating device which shakes all the sand out of it. The sand falls through a grating and thus re-enters the circulating system. The cope is returned to the molding machines. The drag and casting continue moving to the end of the line where they are dumped as described previously.

Four cooling conveyor lines installed by the Palmer-Bee Co., Detroit, carry the castings to the cleaning room. Castings have been divided into four general groups to coincide with this arrangement. One conveyor takes the cylinder blocks. A second takes cylinder heads and flywheels. Transmission castings are carried on the third conveyor and miscellaneous castings fall into the baskets suspended from the fourth conveyor in the installation.

Cylinder blocks are suspended from individual trolleys that carry them from the point of shakeout to the building where the cores are knocked out and then back over a considerable part of the same ground to a point where the conveyor line branches off and leads into the cleaning room. Total elapsed time on the journey is approximately 90 minutes. Castings may be handled by hand, if necessary, by the time they arrive in the cleaning room.

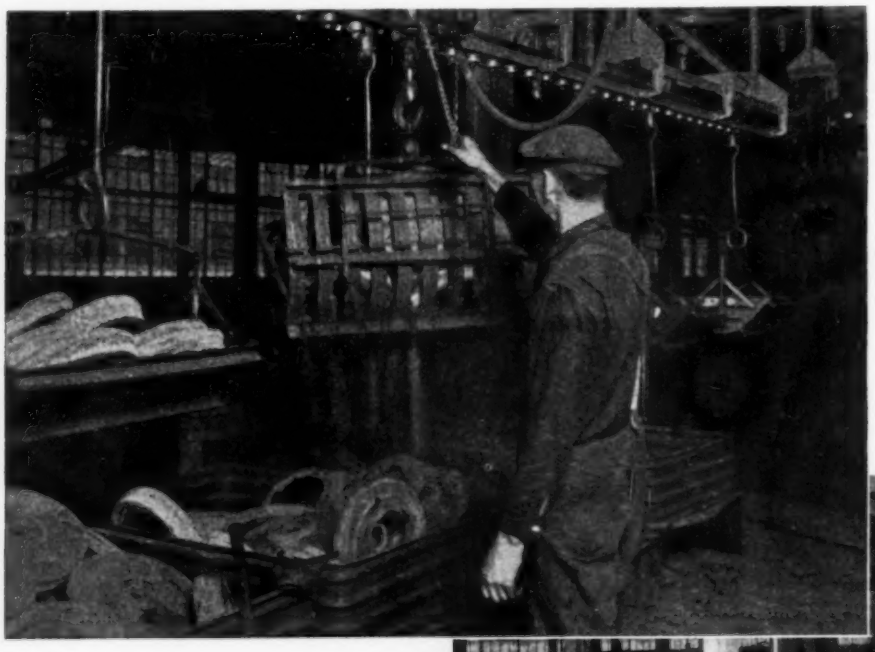
Heat, smoke and dust, usually considered inescapable concomitants of a core knockout room, practically have been eliminated by the simple expedient of providing a two-story instead of the usual one-story building.

The conveyor line enters the upper story, dips at a point part way across the room to allow the suspended casting to enter a violently vibrating shakeout device made by the Stoney Foundry Engineering & Equipment Co., Cleveland. The casting remains suspended from the conveyor while undergoing this vibratory treatment and the instant it is released from the jaws of the vibrator it continues on its way. The shakeout device is adjusted to move with the conveyor for the short distance required to rap all the core sand from the casting.

Core sand, rods, wires, short pieces of pipe, fins and miscellaneous small scrap fall through an opening in the floor on to a belt which runs over a magnetic separator and discharges the iron down one chute to the first floor where it is sorted. Pipes, rods and wires are returned to the core making department if they are in a reclaimable condition. Others are included with the miscellaneous scrap and taken to the cupola stockyard.

Sand falls into a rapidly revolving wire screen which breaks the lumps and discharges the sand into a water tank below the ground floor of the building. A stream of water entering from the bottom keeps the sand and water in a state of agitation and prevents the sand from settling on the bottom. A pump continually sucks an equal volume of the sand and water mixture from the tank, drives it through a 5-inch pipe several hundred feet in length and discharges it over a low lying area of the company's property on the west side of the foundry.

Flywheels, cylinder heads and other castings are loaded into crates suspended from individual trolleys and are carried through the same cooling period, but not through any knockout device. They are discharged into containers in the cleaning room and are taken directly to the sandblast or the tumbling barrels. The conveyor lines outside the cleaning room and knockout building are covered



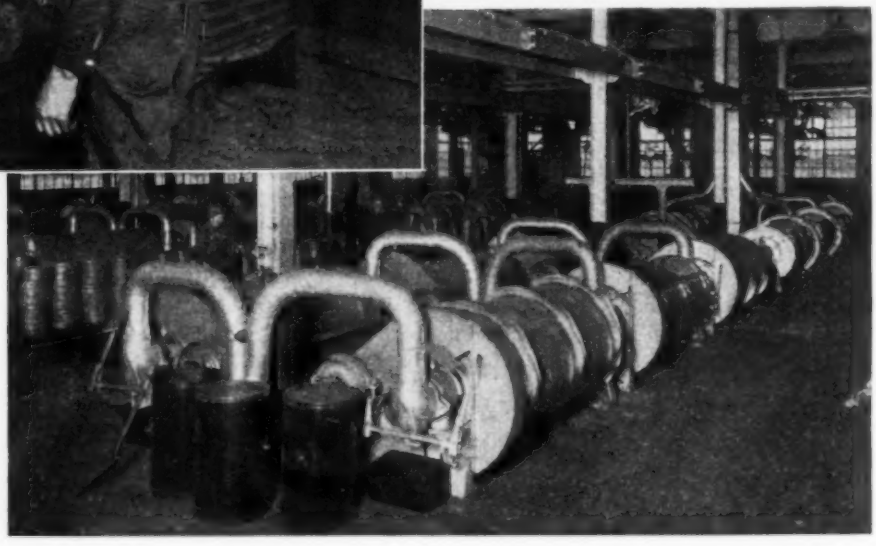


Fig. 12 (Above)—Small Castings Are Dumped From the Conveyor Baskets Into Skid Boxes. Fig. 13 (Right)—Main Pipes Located Under the Floor Remove All the Dust From the Tumbling Barrels

by an asbestos roof supported on a steel frame to form a cooling shed without sides and permit the necessary circulation of air throughout the entire distance. On all conveyors the trolleys are spaced on 4-foot centers. Each conveyor is driven by a 3-horsepower motor and the carrying capacity of each trolley is 500 pounds.

The cleaning room 120 x 350 feet is floored with wood blocks and the light, heat and ventilation features are on a par with these features in other departments of the plant. Dust arrester systems attached to the various groups of sandblast and tumbling equipment keep the air in good condition.

All the castings are tumbled in a battery of 40 tumbling barrels made by the Whiting Corp., Harvey, Ill. As a preliminary to the tumbling process, the cylinder blocks pass through a sandblast chamber made by the Pangborn Corp., Hagerstown, Md., and a considerable number of the smaller castings are treated in a combined sandblast and tumbling device built by the American Foundry Equipment Co., Mishawaka, Ind.

Cylinder blocks suspended from the sand conveyor on which they commenced the journey, emerge from the sandblast chamber and are lifted off with a small air hoist and lowered on to a roller conveyor on which the casting is pushed by hand to a second roller conveyor located at right angles to the first. These two conveyors, others which extend parallel to the lines of tumbling barrels, and still others on which the castings move past the inspection and testing stations, were supplied by the Matthews Conveyor Co., Elliott City, Pa.

Lifting castings by hand is practically unknown in this cleaning room equipped with a 1-ton single I-beam air hoist made by the Whiting Corp., Harvey, Ill., in each of the eight aisles into which the cleaning room is divided longitudinally. With the exception of one battery of four tumbling barrels, the remainder of the total number of 40 barrels is arranged in groups of 12, six on each side of the row of columns. Each group of six is driven by an individual motor through a gear reducer located midway on the shaft. Operation of each barrel is controlled individually through a clutch and brake.

This arrangement of the barrels provides maximum aisle space, simplifies the piping system connected to the dust arresters and takes full advantage of the crane service designed for loading and unloading 12 tumbling barrels. Each of the tumbling barrels is 36 inches diameter, 80 inches in length and is equipped with the latest type door clamps developed by the Whiting Corp.

Immediately after leaving the sandblast chamber, the cylinder blocks are ground on the head end by one of three swing grinders made by the Mommert & Dixon Co., Hanover, Pa. An angle iron frame, plus the weight of the cylinder block, holds the casting in position on the roller conveyor during this grinding operation. Castings are placed inside the frame and removed by one of the aisle cranes. The casting then is pushed along the roller conveyor line and lifted into one of the tumbling barrels.

After it has been tumbled sufficiently it is replaced on the conveyor line which carries it past the chippers, men who remove any small stray wires from the inner passages, inspectors, water testers and final inspectors. The water test is applied in a special rolling device shown in Fig. 14 which incorporates a section of the roller conveyor in the bottom. Testing a cylinder occupies only a few seconds.

Defective castings are rejected, perfect castings pass on to the shipping dock at the north end of the cleaning room, and castings with minor defects are switched to a furnace where they are heated to a bright red, then removed and the minor defects are repaired by welding.

Cylinder heads and other castings are trimmed on a battery of six double stand stationary grinding machines made by the Black & Decker Co., Towson, Md., and located at the south end of the conveyor lines. A similar battery for supplementary grinding is located at the north end of the same lines.

Fig. 14 (Left)—Cylinder Blocks Are Water Tested in a Movable Frame. Fig. 15 (Right)—Castings Are Inspected and Any Remaining Small Rods Are Removed Before the Castings Are Water Tested

This is the last of a series of four articles dealing with the new foundry recently placed in operation by the Oakland Motor Car Co., Pontiac, Mich. For convenience of presentation the subject was divided into four sections which were published respectively in the July 15, Aug. 1, Aug. 15 and the present Sept. 1 issues of THE FOUNDRY.

Form Supply Company

Interstate Supply & Equipment Co., Milwaukee, has been incorporated to act as distributors for products of the Federal Foundry Supply Co., Cleveland, in portions of Wisconsin, Illinois, Iowa, Minnesota and upper Michigan. In addition the new firm will handle foundry equipment, supplies and foundry sands. The officers of the new company are Walter Gerlinger, president; H. R. Donald, vice president and treasurer; and R. S. Witte, secretary.

Questions & Answers on FOUNDRY PRACTICE

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Steel Casting
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

MALLEABLE

Castings Lose Weight

QUESTION

Have you any information on the loss of weight that occurs when white iron for malleable castings is annealed? Is it possible to express this loss in per cent per 100 pounds?

ANSWER

In malleable annealing, castings lose weight during the anneal by the removal of carbon as carbon monoxide and by the removal of scale which is the oxidation product of the metallic iron. The amount of this loss as a percentage of the total weight of castings obviously will depend upon the ratio of surface to volume of the particular castings under consideration. Accordingly no specific answer is possible. Loss from decarburization can be brought commercially as low as 0.10 per cent but this is unusual. In quite small castings this loss may run as high as 1½ per cent with ordinary pot annealing. The character of the furnace gases and the dimensions of the casting may produce any degree of decarburization between the two extreme values given depending upon circumstances. The amount of iron removed as oxide during soft cleaning depends upon the same conditions and upon the perfection with which the cleaning operation is executed. The conditions may be so variable as to make it even more difficult to supply an approximation than in the case of the carbon loss.

Heavy castings annealed in a properly controlled furnace atmosphere may oxidize only a fraction of a per cent of iron, and small castings poorly protected may oxidize a great deal. In extreme cases not to be expected in ordinary practice castings have been known to lose 1/5 of their weight. Considering a line of castings of medium weight annealed under good commercial conditions, the total loss may be of the order of magnitude of 1½ to 2 per cent, but as already pointed out may be greater or less in special cases. No consideration has been given to the loss in weight due to removal of gates and feeder mouths after annealing. This is a loss encountered in finishing and not in annealing although it frequently makes up a noteworthy difference in weight between castings passing between the trimming room and the shipping room in the malleable foundry.

STEEL

Two Slags Necessary

QUESTION

We are making approximately 200 tons of miscellaneous steel castings a month in a basic-lined, 1½-ton electric furnace. Our scrap is foundry returns, railroad scrap, spring steel, rails, nuts and bolts, and heavy tire turnings. Lately we have been having trouble with our phosphorus running up to 0.065 per cent and sulphur up to 0.07 per cent. When this was discovered we analyzed the nut and bolt scrap and found that it contained about 0.08 per cent phosphorus, and 0.12 per cent sulphur. Due to the shortage of selected scrap we are forced to use considerable quantities of this scrap. Our melting practice consists of two periods; the oxidation period during which the metal is melted down and slag is formed from rust and scale on the scrap—no lime is used in this period. After this slag is run off, we make a carbide slag using 100 pounds of lime and 20 pounds of coke and maintain a reducing atmosphere in the furnace. Is there any way that we can reduce the phosphorus and sulphur without increasing the time for finishing as now practiced?

ANSWER

Since phosphorus is removed under strongly oxidizing conditions and a basic slag, we believe that you can reduce your phosphorus considerably during the oxidation period by using lime in the first slag. An amount of lime equal to from 2 to 4 per cent of the weight of the charge will eliminate around 0.03 to 0.04 per cent phosphorus. The lime may be added under the electrodes as soon as the first pool of metal forms. Raise the electrodes when they have dug a deep hole, and add the lime and then fill the cavities with fresh scrap. Add about half of the required amount of lime in these holes and the remainder as soon as a fair sized pool is formed. Ordinarily the entire amount will be in the furnace about 45 minutes after the current is on in a furnace taking 2 hours to melt the charge. The amounts of phosphorus eliminated may be increased by the addition of sufficient amounts of ore to keep the bath in a steady boil, or in special cases more than one dephosphorizing slag can be used.

If the slag gets thin and watery more lime must be added to keep the slag fairly thick. When the bath has melted completely and is hot enough to maintain its molten condition for 10 or 15 minutes, the current is shut off and the slag removed. After the first slag is completely removed, the calculated amount of ferromanganese is added to bring the manganese to the desired point. After allowing a few minutes for the ferromanganese to diffuse through the heat the second or deoxidizing slag is

added in the furnace covering the bath.

Since you use a carbide slag, this procedure will be followed. This slag will amount to 4 to 7 per cent of the charge depending upon the amount of sulphur to be removed. Seventy per cent of the slag-forming material will be lime and 30 per cent ground fluorspar with about 50 pounds of coke dust. If the carbon is low or you have a considerable leeway between the residual carbon and that desired, dust the bath with ground coke and add about half the slag. Dust the surface again and seal the furnace. After the furnace is good and hot and the slag has turned to a steel gray color, powdering in air, the remainder of the slag mixture is added and the furnace allowed to run until the slag attains the proper consistency. This operation probably will take longer than your present method, if you wish to bring about a satisfactory elimination of the sulphur.

GRAY IRON

Increase Scrap Content

QUESTION

I operate a foundry in Argentina, and would like to know in what proportions and which materials I should use to obtain kitchenware with a smooth surface and without pores. At present I am using 60 per cent agricultural machinery scrap and 40 per cent ingot of the following composition: Silicon, 4 to 5 per cent; manganese, 0.55 per cent; sulphur, 0.03 per cent; phosphorus, 1.75 per cent, and 3.2 per cent carbon. However, the surface of the castings appears granular and is full of pores.

ANSWER

We believe that your difficulty is caused by what is known in America as a soft, open iron. According to our calculations your finished castings contain over 3.0 per cent silicon, 1.12 per cent phosphorus and 0.45 per cent manganese.

You do not state whether you have any pig iron (ingot) containing a lower amount of silicon than 4 to 5 per cent. If you have, you could use it instead, and reduce the silicon content of your castings. However, since this information is lacking, we suggest that you change your mixture to the following: Use 80 per cent scrap and 20 per cent pig iron. If you watch your melting carefully, you should have no difficulty in obtaining good castings. The mixture described will give castings with a silicon content of 2.65 per cent; phosphorus about 0.90 and manganese about 0.45 per cent. The manganese is lower than desirable as it should be around 0.60 per cent. Addition of ferromanganese (about 3 pounds per 1000 of metal) will raise the manganese to the proper value.

Q & A

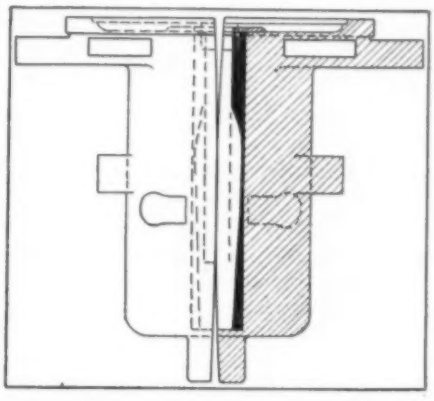
Chill Thickness Varies

QUESTION

Is there any definite relationship between the thickness or weight of a chill and the casting on which it is used. We have tried chills equal in weight to the casting and others half again as heavy, but they break before they have been in service a reasonable length of time. We have particular reference to flat chills on which plates 24 inches square and 3 to 4 inches thick are cast. Also we should like to have some data on roll chills and car wheel chills.

ANSWER

Taking the questions in the reverse order in which they are presented they cover a wider field than pos-



THE FACES OF THE HALF BOTTLE MOLDS TOUCH IN THE CENTER BUT ARE SPRUNG APART AT THE ENDS

sibly can be covered in the space at our disposal. Manufacture of car wheels and chilled rolls represent two highly specialized branches of the foundry industry. They also prove that no universal rule can be applied by which the thickness or weight of a chill can be determined from like factors in the casting. For example the usual custom in roll shops is to make the wall of the chill half the diameter of the roll up to 30 inches diameter.

Above the thickness mentioned the accepted practice is to divide the diameter of the roll by 2½ for the thickness of the chill wall. Can you imagine trying to apply that rule to a car wheel? Foundrymen engaged on chilled work draw up empirical rules based on experience, observation and the character of the iron which market or geographical conditions forces them to use.

A description of roll chills and their application by the late H. E. Diller was published in THE FOUNDRY, Aug. 15, 1921. Chills for car wheels were described by the same author in the May 15, 1920 issue of THE FOUNDRY. The description formed part of one article in a series of six running consecutively from April 1 to June 15 and covering practically every feature in the manufacture of chilled, cast iron car wheels.

Coming now to the first question on the list, you will find that the composition of the iron in the chills is more important than the thickness. Of course a reasonable thickness is required to extract the heat from the casting and thus impart the desired depth of chill, but the composition of the iron will determine the life, in other words how often the chill will expand and contract before it cracks. For your 24-inch plates we suggest a chill 5 inches thick made from bessemer iron of the approximate analysis of a heavy ingot mold: Silicon 1.75 per cent, sulphur 0.07 per cent, phosphorus 0.20 per cent, manganese 0.60 to 0.70 per cent.

Q & A

Glass Molds Warp

QUESTION

We are enclosing a sketch of a bottle mold which warps after it is cast. Iron cores are placed in the drag face of these half molds to form the half cavity for the bottle. Afterward the opposing faces of the half molds are planed, the cavities are carefully tooled by hand to the required shape and suitable guides are placed on the two half molds to guide and hold them in position when in use in the glass factory. These molds are poured from iron of the following analysis: Silicon 1.85 per cent, sulphur 0.05 per cent, phosphorus 0.04 per cent and manganese 0.79 per cent. Can you suggest a suitable analysis that will prevent the molds from warping?

ANSWER

The analysis of the iron has nothing to do with the warping of the molds. With the exception of the phosphorus content the analysis given is recognized as suitable for these castings. We are inclined to the opinion that the decimal point for the phosphorus is misplaced in your inquiry and that the figures really should read 0.49. If the castings had warped in a manner to bring the ends together with a bow in the center we should say the chill was responsible by cooling the bottom face too rapidly and thus causing it to become shorter. However, with the castings warped in the manner shown in the sketch, that is, with the centers touching and the ends sprung apart, we are at a loss to account for the cause. We suggest you check up carefully on the pattern and mold. The pattern may be warped. The face of the

mold may be rammed too soft, thus permitting the weight of the iron to distort it a little in the center. If a careful examination proves that these features are not to blame then the obvious remedy is to camber the face of the pattern slightly to anticipate the amount it usually warps.

GENERAL

Average Melting Loss

QUESTION

What is the average melting loss on ingot mold stools?

ANSWER

The melting loss on ingot mold stools probably is less than that on any other form of castings. This is due to the fact that the charge is made up entirely or almost entirely of bessemer pig iron, the gates are an almost negligible factor in comparison with the weight of the castings and the amount of iron in the charge may be calculated closely, thus eliminating the factor of over iron at the close of the heat. On a fairly long order involving a 10 or 12-ton heat per day the average melting loss will be approximately 10 per cent. Of this amount 5 per cent will be actually lost, while the remaining 5 per cent will be available in the shape of gates and scrap and may be added to the charge on the succeeding day or disposed of in any other manner that may seem advisable.

Q & A

Casting Is Distorted

QUESTION

We are making a diesel engine cylinder with a 10-inch bore and weighing about 700 pounds in a green sand mold. Inside the water jacketed section the metal is 1¼-inch thick and outside it is 1 inch. The remainder of the casting is only ⅝-inch thick. After the casting is bored out it goes out of round 0.004-inch. After the surface is ground to a finish the distortion is increased and after the finished casting has been handled a few times in the shop the distortion amounts to 0.012-inch in the diameter of the light end of the casting. We shall appreciate information on how to prevent the casting from changing shape.

ANSWER

Internal strains are set up in all castings of this kind on account of the variation in thickness between adjoining sections. Unless the utmost precaution is observed these strains will be accentuated by the manner in which the main core is held off center. Under ordinary jobbing conditions the core is calipered a trifle *slack* to prevent a crush or the prints are *shaved* for the same reason. In either case it is a moral certainty that the core is not held perfectly in the center of the mold. The result is that the metal is thicker on one side of the casting than on the other and consequently contraction strains are set up while the casting is cooling. Some foundrymen have found it advisable to *age* the castings for several months so that the molecules might adjust themselves permanently. A second method and one that accomplishes the same result in a shorter time is to heat the castings to a red heat, approximately 1000 degrees Fahr., and then allow them to cool slowly. This treatment releases the strains and no further distortion will take place as a result of machining operations. In theory the original casting as it comes from the mold is in a strained condition, but gradually will adjust itself if allowed to stand long enough. The first roughing cut taken by the machine removes some of the coating of metal that is holding the remainder in tension and distortion takes place.

Individual cases require individual treatment and we suggest the following remedial measures to your attention: (1) anchor the core firmly in the exact center of the barrel to insure an even distribution of metal; (2) leave the casting in the mold until it becomes cold; (3) take a roughing cut through the bore, then heat the casting slowly to a temperature of approximately 1000 degrees and afterward allow it to cool slowly. One or all these treatments will remove any tendency toward distortion after the final finish is imparted to the inside surface. In many instances the accurate centering of the core is all that is required. In other instances it becomes necessary to resort to the heat treatment outlined.

Q & A

Cores for Large Jobs

QUESTION

We have had trouble with the cores in some of our heavy semi-steel castings. The iron appears to enter the sand and melt the core to a certain extent. We shall appreciate any information you can give us on a formula for a core sand mixture that will prevent trouble of this kind.

ANSWER

The fusible element in a core is the natural bond in the sand from which the core is made. Therefore to prevent the sand from fusing it is necessary to eliminate this bond in cores where the sand is exposed for any length of time to the direct influence of molten iron at a high temperature. The ideal sand for this purpose is silica sand which has no natural binder and which has a melting temperature considerably higher than iron. This sand may be bonded with practically any of the core binders on the market. The artificial bond burns out in the shape of gas when the casting is poured, leaving the sand disintegrated so that it may be removed. A large vent hole in each core facilitates the escape of the gas and a correspondingly easy removal of the sand, later.

All the manufacturers of core binders are prepared to furnish literature and information on the subject of core sand mixtures for all purposes.

Q & A

Slag Hole Necessary

QUESTION

Since we started using miscellaneous iron and steel scrap in our cupola for the manufacture of sash weight castings we have experienced considerable trouble on account of the slag getting up into the tuyeres. The cupola is provided with a spout at the back but it never has been used. The hole in the shell has been bricked, because we always have been under the impression that this hole was an emergency device in case the iron in the cupola rose too high before it was tapped. We never allow more than 3000 pounds of iron to accumulate before it is tapped and for that reason we never have had occasion to utilize the emergency outlet at the back of the cupola. Possibly this outlet originally was designed as a slag outlet, or it may be used for that purpose. We shall appreciate your opinion on the subject.

ANSWER

The slag spout was placed on the back of the cupola deliberately by the manufacturer to remove the slag from the inside of the cupola. You probably only have been running short heats where the quantity of slag did not amount to a volume that would interfere with the functioning of the cupola. With clean material a cupola may be operated for a couple of hours without removing the slag. Usually it is safer to start the slag running before an hour has elapsed. This is essential if the cupola is expected to be kept in blast for a considerable time, say several hours. Even on comparatively short heats it is better to remove the slag through the slag hole than allow it to accumulate in the cupola where it sticks to the wall and gradually builds out toward the center. In your particular case where the production of slag is greater than usual, its removal is essential. Take out a brick or two and provide an outlet to the spout at the back of the cupola. You may have to add a little more limestone than usual to liquefy thoroughly the

slag so that it will run readily. The slag hole may be left open throughout the duration of the heat. Occasionally the stream will cease for a short time when the metal is low in the well, but most of the time the slag will flow in a steady stream. An evidence of ideal slagging condition is found when a certain amount of the slag is converted by the blast into a light downy substance that may be noticed flying through the air in the room back of the cupola. It is known among foundrymen as *slag wool* and can be seen sticking to the walls in all foundries where the cupola is operated properly.

Q & A

Casting Warps on Chill

QUESTION

We have had trouble in making a rectangular iron casting 2½ x 4 x 24 inches. The 2½-inch face has to be cast against a chill and although we have tried several methods, the face invariably comes concave instead of straight. We shall appreciate your advice on how to secure a straight face on the casting.

ANSWER

The surface of the casting which touches the chill, solidifies and commences to contract before the remaining body of iron in the casting. This is a natural phenomenon and cannot be prevented. However, it can be controlled to a certain extent. The method of control adopted depends on several factors among which the principal one is the shape and size of the casting. Two methods are available in the case you present. The first is to use two chills on the casting, one on the side which has to be chilled, the other on the opposite side. However, this idea may not be feasible in the case in point. In your case we suggest that you provide a new chill with a slightly concave surface. The concave surface to correspond with the present variation from a straight line on the face of the casting. Logically the same contraction that now pulls a straight line concave, will pull a convex line straight.

Q & A

Gates Cause Defects

QUESTION

We are forwarding for your inspection a piston ring casting 3¼ inches in diameter, 2 inches high with ⅛-inch thickness of metal. May of these castings, including the one we are forwarding, show defective areas under the gate. The entire mold is made in green sand on a jolt-squeeze-strip machine and each ring is gated at the top through a flat horizontal gate ⅛-inch thick by 1 inch in width. We have tried a double runner, also a strainer core in the sprue, but without relief.

ANSWER

This casting belongs to that peculiar class in which absolute cleanliness of gate and mold is even more essential than the shape or position of the gate. Skimmer gates and dirt catchers are useful in their places, but they are not infallible preventatives. The dirt which shows in the casting we have received is the result of a small film carried in with the stream of iron. It has stuck to the walls of the mold directly under the gate and the clean metal has filled the remainder of the mold. Even in the cleanest mold it is almost impossible to prevent the stream of iron from washing up a small film of dust. In a thick casting, or one in which the surface is not machined, this never is noticed, but it is impossible to conceal it in a thin piston ring casting machined all over. Molds that are left standing for several hours before they are poured become dried on the surface. The skin on some kinds of molding sand becomes hard and firm, while on others it becomes powdery. We suggest you spray the gates and runners with gasoline or kerosene oil. This will keep the sand in good condition and will prevent the formation of a film of dust when the stream of iron falls on it. Arrange a set gate in the drag so that the metal from the vertical runner in the cope passes through a strainer core into a well which in turn feeds the gates leading to the individual molds. As an extreme precaution it may be advisable to mount a half ball on the cope side of the pattern plate above that point in the drag where each gate emerges from under the strainer core. This cavity in the cope will catch any floating dross in the stream before it finally enters the mold. Also, you might reduce the size of the gate and use two branches instead of one.

Problems in Nonferrous Founding

By Charles Vickers

Changes Furnace Size

We are operating one coke-fired natural draft furnace on brass. This furnace is 18 inches diameter and 36 inches deep from the grate, with a flue 6 x 4 x 12 inches long, leading into a chimney 20 x 20 inches inside measurement and 30 feet high. We use No. 40 crucibles and can get out a heat in from 2 to 2½ hours. We would like to increase our melting capacity and we wonder if it would be good practice to connect, by a long flue, 12 x 15 inches area, 4 brass furnaces; two for No. 200 crucibles, one for No. 60 crucibles, and another for a No. 40 crucible? Would 24 inches diameter and 40 inches deep be about right for the No. 200 size, and should there be some kind of a stand built up through the grate bars for a crucible of this size, or would it be perfectly safe resting on the coke as with the smaller pots?

The present furnace we consider entirely too large for a No. 40 crucible. An 18-inch diameter furnace will take a No. 70, 80, or 100 crucible. For a No. 35 or 40 crucible, a furnace 16 inches diameter and 25 inches deep is correct, and three such furnaces can be attached to a 30-foot stack, 18 x 18 inches diameter. It will give good service provided the stack stands free and is not outtopped by buildings close by. In that case the stack will require to be lengthened until it is higher than all adjacent buildings. The furnace flues should be rectangular cast iron pipes 8 x 6 inches inside area, and about 14 inches long to span the opening between the furnace lining and the flue opening. Coke-fired furnaces must not be made too deep. Thirty-six inches is just about one foot too deep for a No. 35 or 40 pot furnace. The deeper the furnace the more difficult it is to pull the pots. Therefore, 25 inches or so is enough for a No. 40 pot. To make the furnace deeper and wider means wasting fuel.

A furnace 22 inches diameter and 34 inches deep is large enough for a No. 150 crucible, so that a 24-inch diameter furnace might be a trifle small for a No. 200 pot, and we suggest making it 25 inches diameter by 36 inches deep. The figures for the diameter and length of a furnace for any size crucible can be arrived from the measurement of the crucible it is to contain. For any

crucible under a No. 70 three inches of coke around it will be about correct; for a No. 100 crucible, allow 3½ inches; for a 150 or 200, 3½ to 4 inches of fuel will be required. Under the crucible allow from 4 to 8 inches of fuel according to the size of the crucibles, and when the pot is set on this depth of fuel its top must reach about 2 inches above the bottom of the furnace flue. Use a dome-shaped cover with a hole in the top 1½ inches round into which a bent length of ¾-inch round iron can be inserted for rolling the cover off or on. This permits the use of a deepener on top of the crucible and greatly shortens the melting period and prevents oxidation of the metal. The grate bars must never under any condition come tight up against the bottom plate of the furnace. The furnace must be so designed that the grate bars hang about 2 inches below the furnace plate. This is important for those who want to melt. As far as a stool is concerned, one cannot be built up from the floor, and be practical. For large crucibles a stool is necessary, because the pot when filled is too heavy to be lifted up when molten. Put the stool on the grate bars. Use good grade fire brick, and have the stool large enough so the walls of the pot can rest on it as well as the bottom. This will avoid bottom leakage due to the bottom of the pot being pushed up. We also would favor a higher stack than 30 feet and 20 feet additional would be a great help for the new furnaces.

Q & A

Encounters Difficulty

In casting aluminum bronze of the composition 90 per cent copper, 10 per cent aluminum we experience trouble from dirt and dross on the upper surfaces, although other parts of the castings are by no means free from defects. Will you kindly inform us of the correct way to mix the metal, and also what is the proper pouring temperature. We have melted the aluminum first, and again the copper first, and sometimes we have good luck and again not. We find that sometimes one casting will be good, and the others not, out of the same pot of metal. The castings run from 1 to 360 pounds each in weight and some are cored and others not. We are sending a casting for your inspection. Stock has been removed to the extent of ⅛-inch from the teeth, and the flat, or top side has been just cleaned. The customer informs us that we should make them clean without any more stock for machining. We would like to know the experience of other foundries with aluminum bronze.

The experience of many brass foundries with aluminum bronze is not encouraging, as a rule to the continued manufacture of such castings, and as a consequence in many foundries it is absolutely barred, not only because of the trouble encountered, but also because it gets mixed in with the nonaluminum containing alloys and so becomes another source of trouble to the harassed foundryman. There are, of course numerous foundries where the alloy has been given the necessary study until a point has been reached where it gives little more trouble than the red brasses, and the losses are not much higher, but to continue this happy state of affairs constant vigilance is necessary. The dross carried by the sample casting is formed right in the mold as the metal flows in. The reason for every casting not being the same, is that the dross formed in the good ones, has failed to come to the surfaces that are machined, but it is in the casting just the same.

For foundry purposes let us assume that the aluminum acts in copper, exactly like soap in water; it saponifies the copper. Suppose we want to fill a glass mold like the casting with soapy water, and fill the mold with the clear suds only, not a particle of foam being anywhere visible. That's a job that requires study. It will be evident that where any two streams meet, where the metal drops, or where it hits against a wall of sand foam will be created. In the case of the metal this foam is metallic and it never subsides so we are impressed with the great importance of getting in the metal without the least agitation anywhere. The first *drop* of the metal down the sprue, and drop in this case means the fall and splash as it hits the bottom, is likely to be a fertile source of dross, so this has to be guarded against. Also when within the mold, the molten metal must not be permitted to climb over barriers of sand to drop into hollows on the other side, as the result will be dross. After considering these matters we note that the best way of pouring such castings is from the bottom, with the flat surface in the drag.

As a general rule aluminum bronze is given more finish than the gun metals, so the customer is wrong as to the amount of finish that should be allowed, as he hasn't enough. The bronze should always be made by melting the copper first, and crucibles are best for this alloy and the copper should be covered, and neither lime, fluorspar, nor any flux containing them should be used in connection with this alloy, as we are dealing with aluminum at quite high temperatures. Pour at from 2100 to 2250 degrees Fahr., according to the shape of the castings.

The 10 per cent aluminum bronze, minus iron is the weakest of the aluminum bronzes, and a chunky casting cannot be expected to have more than 55,000 pounds per square inch tensile strength, and the elongation will not reach 20 per cent. In fact the average of 12 tests was 7.4 per cent elongation, and the tensile strength fell a little short of 50,000 pounds per square inch. Unless the alloy is handled expertly, this result can be expected. It is not a good alloy of aluminum bronze, and when we view the grief experienced in making the castings, and think of the heavy losses the inexperienced foundryman will always have unless he expends a lot of money to master the alloy, it may be said with conviction, that it does not pay to try and make such a comparatively weak alloy. Some alloys of aluminum bronze will run up to 110,000 pounds per square inch tensile, with from 10 to 12 per cent elongation. Other aluminum bronzes will run to 80,000-90,000 pounds per square inch tensile with from 20 to 30 per cent elongation. Such alloys are suitable for use in any place where a strong metal is required, but they are not suitable for worm gearing, or for any bearing purpose as elongation is too high.

Such aluminum bronzes, therefore, are worth while working with, as they have a future, but the straight copper-aluminum, some folks are fond of specifying, is not what they think it is, and the game is not worth the candle. A copper-tin alloy will beat it, because there will be no hidden defects, and its elongation will be so much higher. Consider, for example the alloy: copper, 89.50 per cent; tin, 10 per cent; manganese-copper, 0.5 per cent. This alloy is made by adding 0.5 per cent manganese copper to the copper before the tin, then allowing 5 minutes for refinement before the tin is added. The manganese-copper should contain 30 per cent manganese. This alloy will run 40,000 pounds per square inch and frequently over in tensile strength, with around 20 per cent elongation. Also, it is a good alloy from the foundry point of view. It, therefore deserves consideration wherever the 90 per cent copper 10 per cent aluminum alloy is used.

POURING HEIGHT *Should Be Low* in Casting Aluminum Alloys

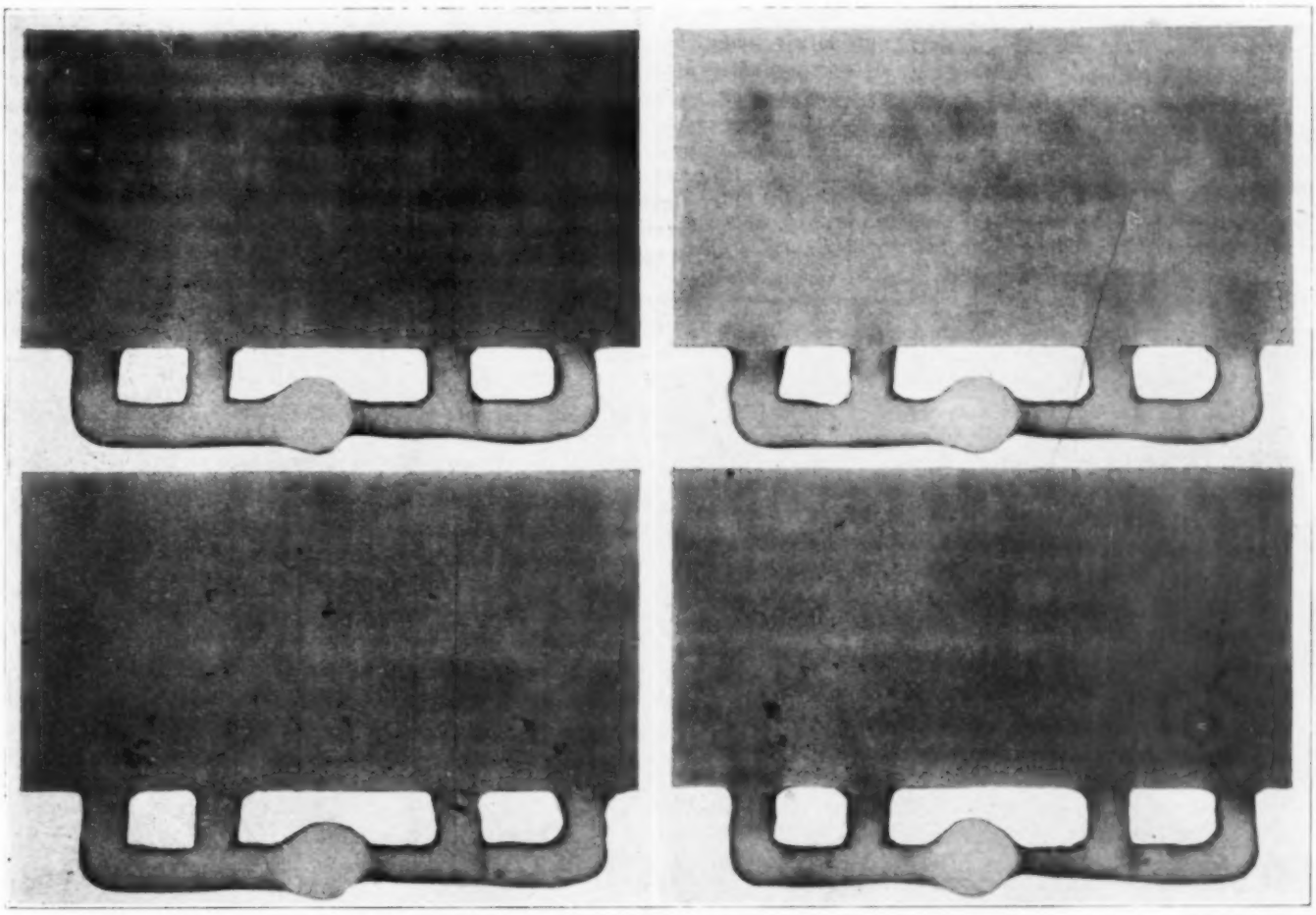
By Douglas B. Hobbs

SOUNDNESS of a casting depends upon many factors, such as pouring height; pouring temperature; method of gating; application of chills; texture, permeability, and hardness of cores; texture, temper, permeability, and cohesiveness of molding sand; and the practice employed in melting and alloying. The effect exerted by pouring height upon the soundness of a casting generally is not realized. Pouring height employed in casting aluminum or aluminum alloys is governed by certain inherent characteristics of molten aluminum, as well as by a number of factors in metal treatment and foundry practice that is involved.

All exposed surfaces of aluminum, whether solid or molten, are covered with a layer of aluminum oxide. This enveloping film acts as a protective coating against further oxidation, but if it is broken, the freshly exposed surfaces are oxidized instantaneously. Because of this action, molten aluminum should be handled as quietly as possible, for the greater the amount of agitation the greater will be the amount of oxidation. This is applicable not only in pouring castings, but wherever aluminum is handled in the molten condition whether it is in alloying, pigging, remelting, or casting.

If a casting is to be free from dross inclusions, the metal should enter the mold without excessive agitation and splashing. The importance of pouring height in minimizing agitation is illustrated well in the pigging of an ingot, which incidentally is one of the simplest forms of a casting. The ingot mold should be held as close to the tapping spout as possible, or, if pigging is done by means of a crucible or ladle, the crucible should be held close to the ingot mold. At no time during the pouring of an ingot, or casting, should the stream of metal be broken.

The amount of oxidized material on the unskimmed surfaces of two 30-pound ingots of the composition: Cop-



FIGS. 1 AND 2—GATED AS IN *A*, FIG. 8 AND POURED AT 1250 AND 1400 DEGREES FAHR. RESPECTIVELY. TOP ROW POURED FROM 1-INCH HEIGHT AND BOTTOM FROM 12-INCH HEIGHT

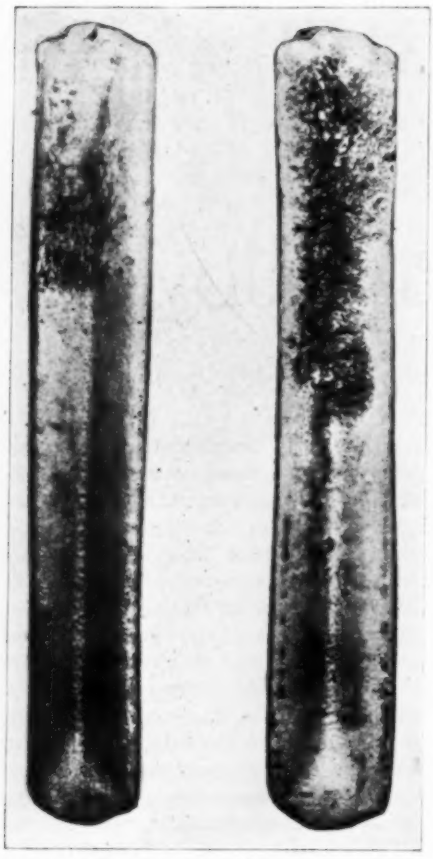


FIG. 3—LEFT INGOT POURED WITH CRUCIBLE RESTING ON MOLD; RIGHT FROM A 12-INCH HEIGHT

per, 7 per cent; zinc, 2 per cent; iron, 1.25 per cent, and aluminum, remainder, poured in different ways, is shown in Fig. 1. The ingot on the left was poured from a crucible held with its lip in contact with the ingot mold, while the ingot on the right was poured from a crucible held 12 inches above the top of the ingot mold. From ingots poured in the first way 0.21 per cent oxidized material was removed on skimming, while from ingots poured in the second manner 0.67 per cent was removed. More important perhaps than the loss, caused by pigging an ingot from an appreciable height, is the fact that some of the oxidized material may remain in suspension within the ingot, and eventually find its way into a casting.

Method of Gating

A sound casting must be free from dross inclusions, and air pockets, as well as other foundry defects. The amount of dross within a casting is due largely to the agitation incident to the pouring of it. This may be minimized by gating the casting in such a manner that the metal will enter the pattern cavity quietly and evenly, and by pouring the casting from the lowest possible height. Often the sprue is so located in the mold, or the casting is poured by means of such a large crucible or ladle, that the ladle must be held from 6 inches to 2 feet above the top of the sprue. Such variables as these naturally affect the quality of the casting, and steps should be taken to eliminate them so that the casting may be poured from an even lower height. Air pockets are caused by air, which has been sucked in through the sprue as the casting is poured, becoming trapped within the casting. The tendency to suck air into the pattern cavity may be overcome partially by gating although much depends upon the way in which the casting is poured.

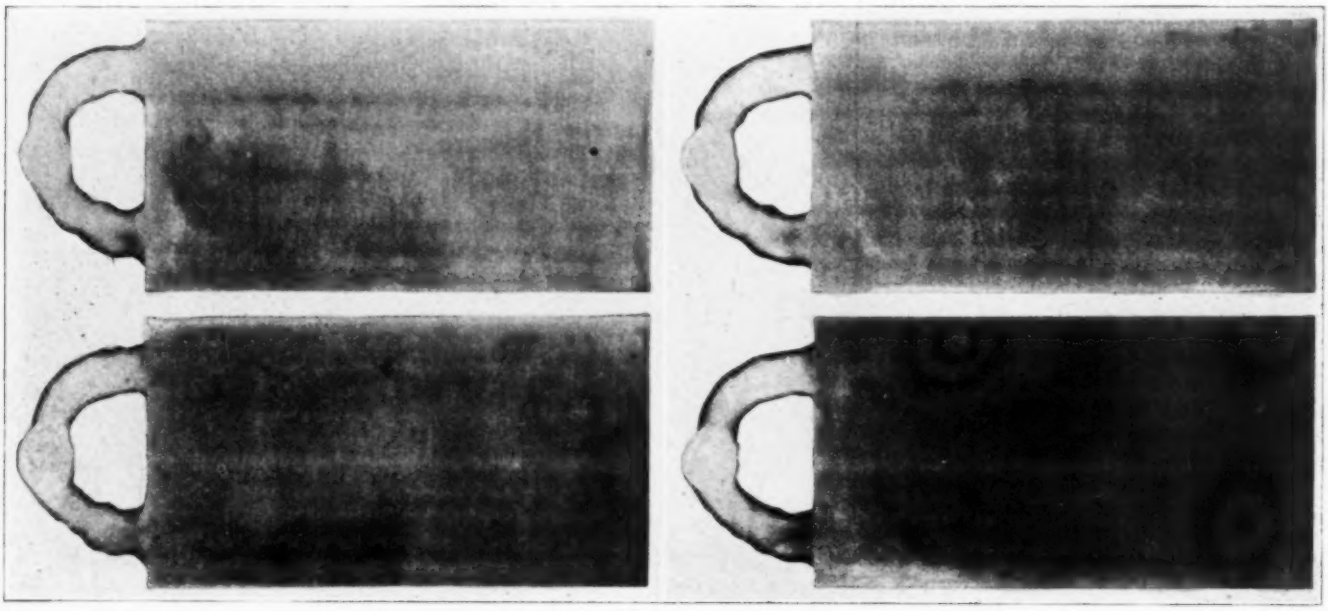
By pouring the casting from a low height the chances for air being sucked into the pattern cavity are lessened. Mold gases also may become trapped, but by correctly arranging the gates and risers, and by using sand of sufficient permeability, the amount of gas trapped in this manner may be reduced. From this, it is apparent that the quality of a casting depends largely upon the height at which it is poured, and upon the manner in which it is gated.

Depends on Conditions

The best results always are obtained with the lowest pouring height. However, it is possible to obtain poor results with a low pouring height and a certain method of gating, and better results with the same or even greater pouring height and a different gating. There are times when an increased pouring height is used to fill the mold. Where possible, it would be better to change

Shows Effects

WHEN molten, aluminum and its alloys oxidize and become covered with a firm, tenacious film unnecessary agitation through careless stirring and pouring breaks this film and allows it to be carried into the mold where it causes defective castings. Much of this type of defect may be eliminated by proper attention. In this article the author shows how pouring height affects the resultant casting, and how the difficulties mentioned previously may be avoided. Mr. Hobbs is associated with the Aluminum Co. of America, Pittsburgh.



FIGS. 4 AND 5—GATED AS IN *B*, FIG. 8 AND POURED AT 1250 AND 1400 DEGREES FAHR. RESPECTIVELY. TOP ROW POURED FROM 1-INCH HEIGHT AND BOTTOM FROM 12-INCH HEIGHT

the gates and keep the pouring height low.

Control of pouring height is important when both high and low pouring temperatures are used. When castings are poured at elevated temperatures, there is an increased tendency for oxidation. Lower pouring heights will aid in decreasing the amount of oxidation since agitation will not be as great. With lower pouring temperatures, the metal is more viscous, and the casting sets more quickly. The faster the rate of solidification, the less chance trapped gases have of escaping; but the faster the rate of solidification, the finer the grain size. With low pouring temperatures, improved physical properties will result, and for this reason it is advantageous to pour as cold as possible. Excessive pouring heights mean that more air is sucked into the mold cavity. Therefore, it is evident that with the lower pouring temperatures as well, care must be exercised to see that the castings are poured from a low height.

Effect of Pouring Height

Effect of pouring height on the soundness of castings, which were gated in different ways, and poured at different temperatures, is shown in the radiographs of slabs ¼ x 6 x 12 inches cast from the previously mentioned alloy depicted in the accompanying illustrations. Unsoundness in the castings is represented by the darker areas in these figures. Three types of gating were used. These are shown at *A*, *B*, and *C*, in Fig. 8. In all but one instance, the runners were of the same thickness as the casting. In the case, shown in Fig. 10, the effect of a choke in the runner is demonstrated.

Some of the slabs were poured from a hand ladle held 1 inch above the top of the sprue, while others were poured 12 inches above the top of the sprue. The sprue on each casting was 5 inches high. This meant a metal drop of either 6 or 17 inches. Pouring temperatures of 1250, 1400 and 1500 degrees Fahr. were investigated. With the exception of one of the slabs in Fig. 11, the sprue was kept filled throughout the pouring operation. In this case, the metal was poured so slowly that the sprue could not be kept filled.

Omits Risers

Such defects as dross inclusions and air pockets may be reduced by the proper arrangement of risers. These defects partially result from improper pouring heights. Therefore, to show the full effect of pouring heights on the soundness of aluminum castings, the risers were left off purposely from the castings described.

Figs. 1, 4, and 7, are radiographs of slabs gated as shown in *A*, *B*, and *C* respectively, in Fig. 8. No chokes were used on the runners, but the sprue was kept filled throughout the pouring operation. The casting at the top of each radiograph was poured from a height of 1-inch above the top of the sprue; and the casting at the bottom, from a height of 12 inches. In all cases, a pouring temperature of 1250 degrees Fahr. was employed. A comparison of each slab

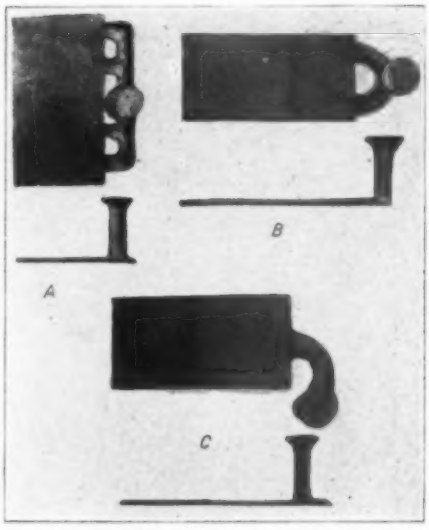


FIG. 8—METHODS OF GATING USED TO SHOW EFFECT OF POURING HEIGHT

poured high, with each slab poured low, shows that the lower pouring heights gave sounder castings. This condition holds regardless of which gating was employed.

In considering the slabs in Figs. 1, 4, and 7, with respect to gating, comparisons should be made with the pouring height held constant. In the castings poured from the greater height, there is so much agitation and so much air sucked into the mold cavity that air pockets caused by trapping mold gases are more or less hidden. With the lower heights, the amount of agitation and the amount of air sucked into the pattern cavity are decreased to such an extent that the differences due to the trapping of mold gases become apparent. Comparing the castings poured high, the

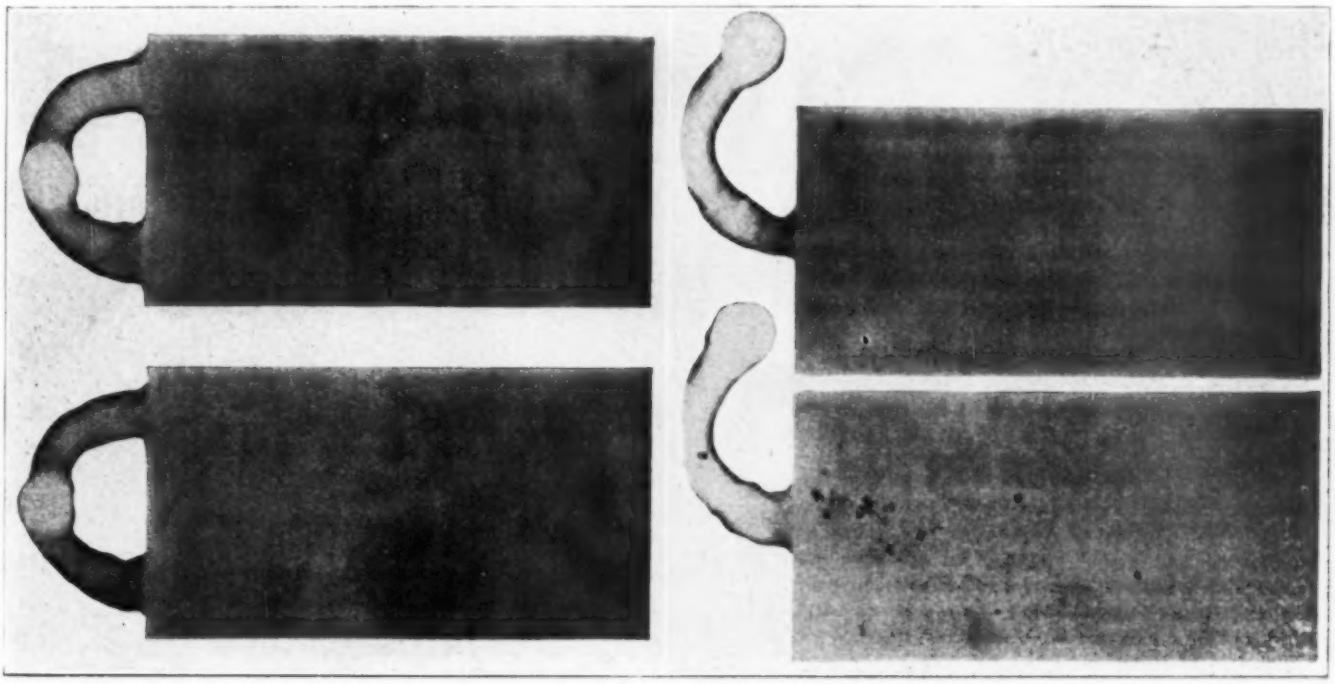


FIG. 6—GATED AS IN *B*, FIG. 8 AND POURED AT 1500 DEGREES. TOP POURED FROM 1-INCH AND BOTTOM FROM 12-INCH HE'GHT.
FIG. 7—GATED AS IN *C*, FIG. 8—AND POURED AT 1250 DEGREES. TOP POURED FROM 1-INCH AND BOTTOM FROM 12-INCH HEIGHT

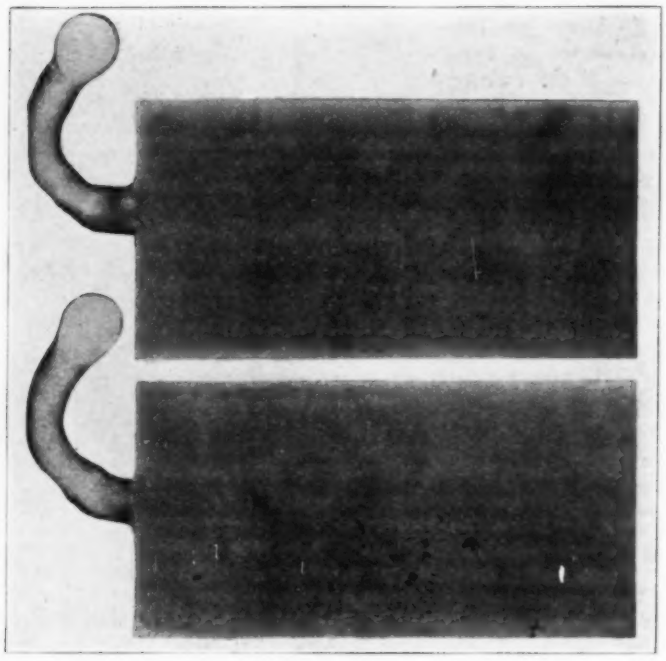


Fig. 9—Gated as in C, Fig. 8 and poured at 1400 degrees Fahr. Top, 1-inch height, runner not choked, sprue filled. Bottom, 12-inch height, runner not choked, sprue filled

slab in Fig. 7 is the worst and the slab in Fig. 4 the best. In the case of the lower pouring height, the casting in Fig. 4 is again the best, but instead of the casting in Fig. 7 being the worst the casting in Fig. 1 is the least sound.

A study of the action going on within the mold cavity in each case as the slab is poured will explain clearly these differences:

Gating A, Fig. 8

With type *A* gating employed on the slab shown in Fig. 1, the metal enters the mold cavity at four points. The mold is filled quickly from these four streams of metal, and the mold gases are likely to be caught. The same condition exists as the streams of metal unite. With this gating, air pockets caused from trapped mold gases are greater in number than with either of the other two gatings. The radiographs of the slabs poured low clearly show this. The distance the metal has to travel and the right angle turns it has to make before entering the mold cavity greatly increase the chances for agitation.

Gating B, Fig. 8

The slabs depicted in Fig. 4 were gated in such a manner that the metal entered the cavity evenly and quietly at two points. The mold is not filled as quickly with this gating as with the one described previously since there are but two streams of metal entering the cavity, and these enter at the end rather than at the side. For this reason, mold gases are not as likely to become trapped. An examination of Fig. 4 shows that the casting poured low has no trapped mold gases. From this, it is evident that the unsoundness in the casting poured high is due to agitation and to air sucked into the sprue.

Gating C, Fig. 8

If the castings are poured low, the gating used on the slabs in Fig. 7 gives satisfactory results. There is little, if any chance, for mold gases to become trapped, but there is a marked tendency for the metal to become agitated during pouring due to the swirling action within the gate. This action may be reduced if the castings are poured with the ladle held 1 inch above the top of the sprue. The swirling action within this gate accounts for the fact that castings gated in this manner and poured from a height of 12 inches are

(*Concluded on Page* 764)

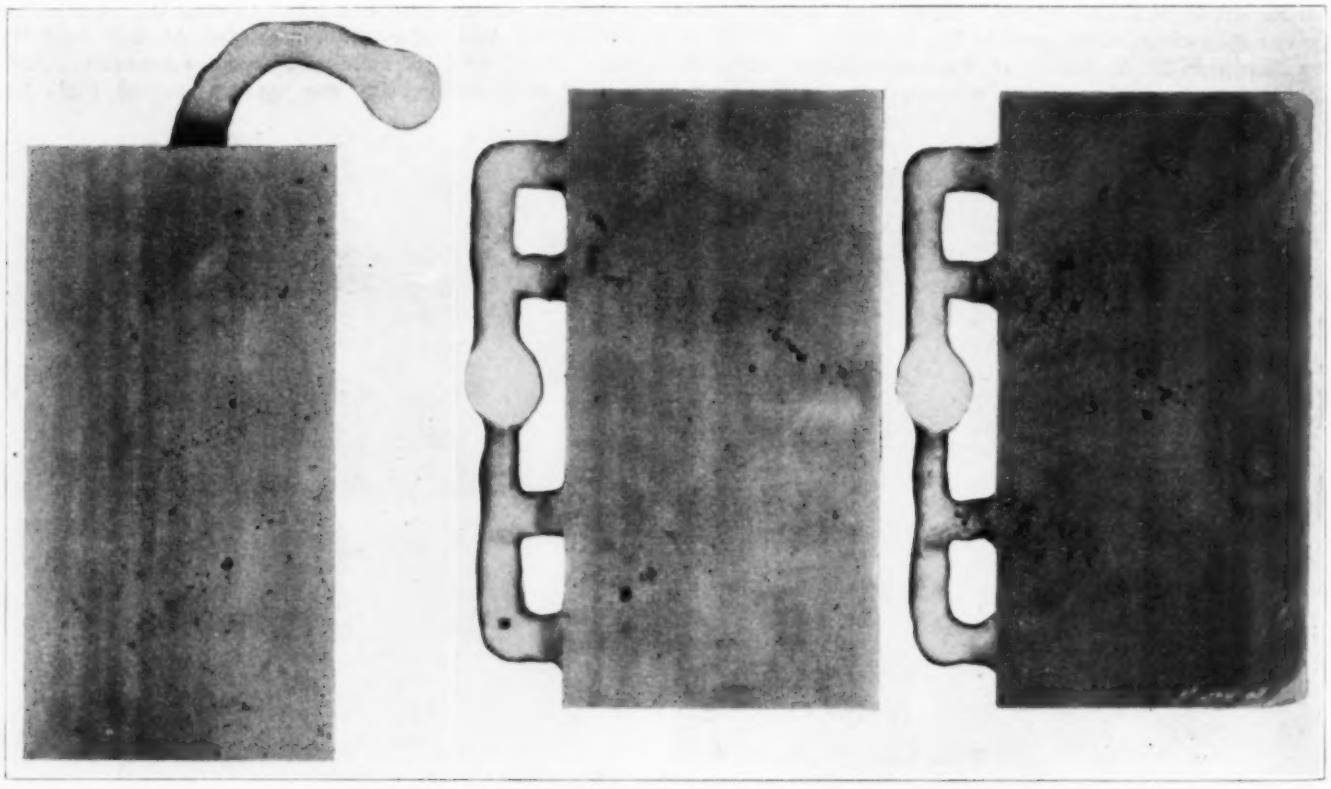


FIG. 10—GATED AS IN *C*, FIG. 8 AND POURED AT 1250 DEGREES FROM 12-INCH HEIGHT. RUNNER CHOKED, SPRUE FILLED. FIG. 11—GATED AS *A* IN FIG. 8 AND POURED AT 1250 DEGREES FROM 12-INCH HEIGHT. LEFT, RUNNERS NOT CHOKED, SPRUES NOT FILLED. RIGHT, RUNNERS NOT CHOKED BUT SPRUES FILLED

The FOUNDRY Family Photograph Album

Upper Left

W. W. WAIRD

Syracuse Chilled Plow Co., Syracuse, N. Y.

Lower Left

J. L. WICK, JR.

Falcon Bronze Co., Youngstown, O.

Upper Right

W. W. PRICE

Buckeye Portable Tool Co., Dayton, O.

Lower Right

C. M. BEATTIE

Jewell Steel & Malleable Co., Buffalo

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

ALUMINUM BRONZE DATA

(*Continued from Data Sheet No.* 778)

Shots, seams and folds are caused by the readiness with which aluminum will oxidize when molten. While in the pot this tendency is checked by the tough skin of oxide which quickly forms on the surface. As soon as pouring commences the stream of alloy is at once similarly coated; and if splashing or spraying occurs when the metal enters the mold, each individual splash or globule immediately receives its own envelope of oxide. This tough and insoluble coating effectively prevents re-union with the main body of metal, unless by accident the oxide layer is mechanically broken down by the general churning. Therefore, such shots or folds become incorporated in the casting without being fused into it, a difficulty which introduces the subject of gating.

In the first place, since splashing is above all things to be avoided, any gate which allows the metal to fall vertically to the bottom of the mold definitely must be vetoed. When this axiom is carried to its logical conclusion it will be seen that it implies bottom pouring in practically every case, via a gate which will lead the metal down gently to the level of the bottom of the mold, whence it can enter the mold cavity quietly and carry all dirt and dross up before it enters the risers. In other words, fill the mold by displacement rather than by a stream falling through air.

Horn gates immediately cross the mind as the obvious solution, but unfortunately they are not so, as can be demonstrated at once by pouring through a horn gate into an open mold. Horn gates have an unsuspected habit of spraying metal right across the mold at high velocity, and if they are used they should be led, not directly into the mold but into a horizontal passage of widening section, into the mold further on.

It is perhaps needless to say that this metal never must be poured into the gate from a height and that the lip of the crucible should rest almost on the gate.

Preferably, let the down gate be a spiral or a series of inclined planes which will lead the metal down without undue velocity or churning. It is sound practice to use at the top of this, a box and plug to check the drawing down of air and dross with the metal. It is of great value with this metal if the usual taper on gates is reversed, so that their cross sectional area gradually increases toward the casting. This will reduce the velocity of the metal on entering the mold. Having by experience found the best gate design for any given casting, cut the sprue off a casting and have it dressed for use as a pattern on subsequent work. Use the smaller section gate from which it is possible to run castings with certainty.

There is usually the choice between connecting gates to thin sections, so that metal will arrive at thick ones somewhat cooler, or to thick sections so that the live metal in the gate will act as a feeder. In the case of aluminum bronze the latter method will be found preferable on the whole.

(*Continued on Data Sheet No.* 780)

ALUMINUM BRONZE DATA

(*Continued from Data Sheet No.* 779)

In the case of the light alloys and many other foundry metals it is definitely an advantage to split up a gate into a number of smaller runners, logically distributed throughout the mold. In the case of aluminum bronze this is definitely a disadvantage because two streams of this alloy seldom reunite perfectly owing to the fundamental tendency to oxidize and dross.

It will be noted that no attempt is made here to specify any particular gate design to meet any one set of conditions. Conditions in routine foundry work are changing continually, but if gates are laid out for any one set of conditions in conformity with the above basic principles, the founder will be saved much unnecessary worry. Obviously, the time occupied, and therefore the cost, must compare unfavorably in many instances with the relative simplicity of brass foundry practice. It should be kept in mind, however, that large numbers of aluminum bronze castings are made in that material because it is literally impossible to meet the conditions with any other metal, and the price obtained is usually commensurate with the abnormal value of the casting to the customer.

Summing up the above, owing to the strong drossing tendency of aluminum bronze, metal must enter a mold quietly. Use slopes rather than abrupt drops, curves rather than sharp turns and use small gates widening towards the casting rather than the reverse, with a box and plug where the cost is justified.

Large internal cavities or draws are due to the shrinkage which occurs when the metal changes from liquid to solid.

The patternmaker's scale which takes care of the subsequent solid contraction, is from 7/32 to ¼-inch to the foot, depending to a certain extent on the design of the casting and the ramming of the mold.

The solidification shrinkage, however, is of a higher order. It is about twice that of common brass, and its effect is emphasized by the extremely small range of temperature over which solidification takes place.

Instead of a plastic period wherein the solidifying metal may adjust itself to its surroundings, there is a more or less abrupt transition from extreme fluidity to a definite solid, and with it an abrupt shrinkage. When a cooling section reaches to within a degree or so either side of 1040 degrees Cent. (1904 degrees Fahr.) it solidifies, and in doing so it draws on neighboring sections for metal to compensate for its shrinkage. It follows that the section or sections to solidify last will bear the whole brunt of the shrinkage, and since any metal will solidify first in contact with the mold walls, the cavities so formed are always partially or wholly internal, and they normally are found in heavy parts of the casting or at the junction of two sections. One of the advantages of the addition of a third element is the widening of the solidification range which is obtained.

(*Continued on Data Sheet No.* 781)

CASTS *Long Pipe* Centrifugally

By Emilio Franchi

FIG. 2—END VIEW OF ONE OF THE MOLDS DURING THE POURING PERIOD

MANY articles and reports illustrating the latest developments in the centrifugal casting of iron pipes for water and gas use have appeared in the technical papers in recent years. This interesting manufacturing process has made such definite progress that even foundrymen who at first were skeptical have revised their ideas and admit that the centrifugal method is a success.

Foundrymen generally are familiar with the De Lavaud system of casting in permanent steel molds water cooled; the Wood and Moore systems of casting in rotating flasks with an inner lining of sand and the Hurst system, but only a few experts know of the Franchi-Gregorini system perfected in Brescia, Italy, although it has been in operation since 1923. After 6 years of experience and continuous production it has reached a high degree of technical efficiency.

In equipping an entirely new foundry for the centrifugal manufacture of cast iron pipes, the Franchi-Gregorini has been guided from the beginning by the following aims:

To place in the market centrifugal pipes of light weight, of medium and large diameters, to extend and complete the application of the centrifugal process.

To produce pipes of lengths greater than 4 meters (13.12 feet) and thus share some of the advantages of steel pipes. Standard lengths now range from 3 meters (10 feet) to 7.5 meters (24½ feet).

To cast in metal molds and not in rotating sand forms and thus profit by the reduction in labor cost.

To cast in heated forms and thus obtain soft tubes, without having recourse to annealing.

Much Work Required

Years of expensive experiments and of careful investigation work from designing and research department were required to determine physical, mechanical and technological laws governing the centrifugal process as applied to cast iron.

The first commercial tubes were produced in 1923. In the intervening years the original equipment gradually has been expanded and perfected to its present definite standard. The present capacity of the plant covers, cast iron pipes of 7.5 meter (24.60 feet), 5 meter (16.40 feet) and 3 meter (9.84 feet) lengths and of varying diameters from 80 millimeters (3.1496 inches) up to 1000 millimeters (39.37 inches).

Casting machines and auxiliary equipment are installed inside a modern concrete building especially designed for efficient charging of the cupola furnaces, for economical handling of coke, pig iron and scrap, for ample daylight, for even and regular ventilation. It answers to the most exacting requirements of the best modern foundry practice, it also provides sufficient area for possible future additions and developments.

The building occupies a floor space of 75 x 85 meters (246 x 318.87 feet) and ample light is afforded by large window openings in the side walls and by the saw tooth roof construction. The necessary cranes and monorail are installed for easy handling of all loads. Air, water and

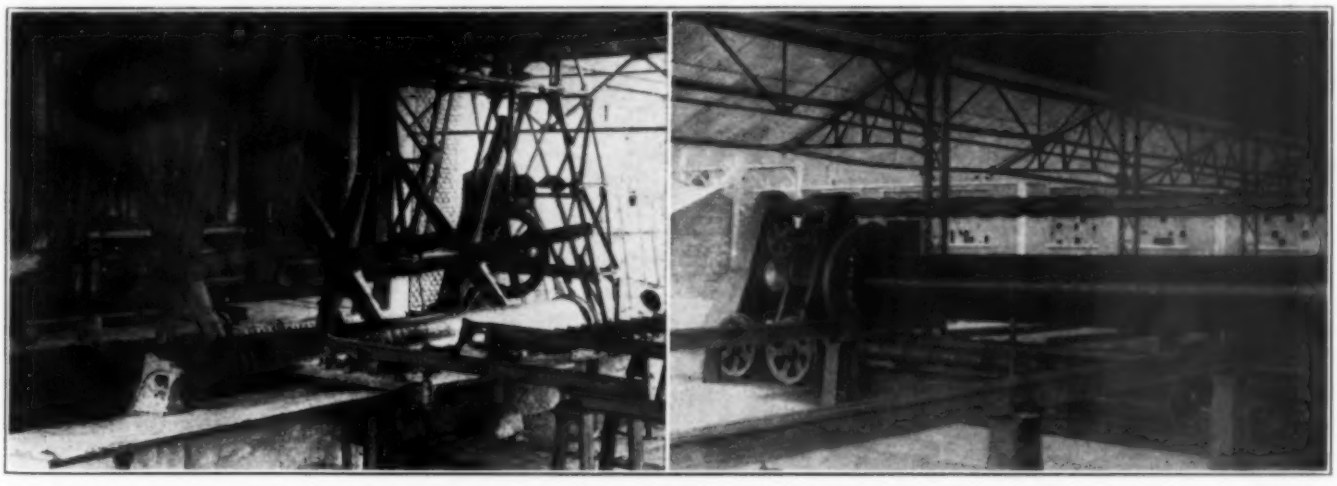


FIG. 1—PIPES WHILE STILL HOT ARE DIPPED IN A TAR BATH. FIG. 3—THE COATED PIPE IS TESTED HYDROSTATICALLY BEFORE IT IS PLAC ED IN STOCK

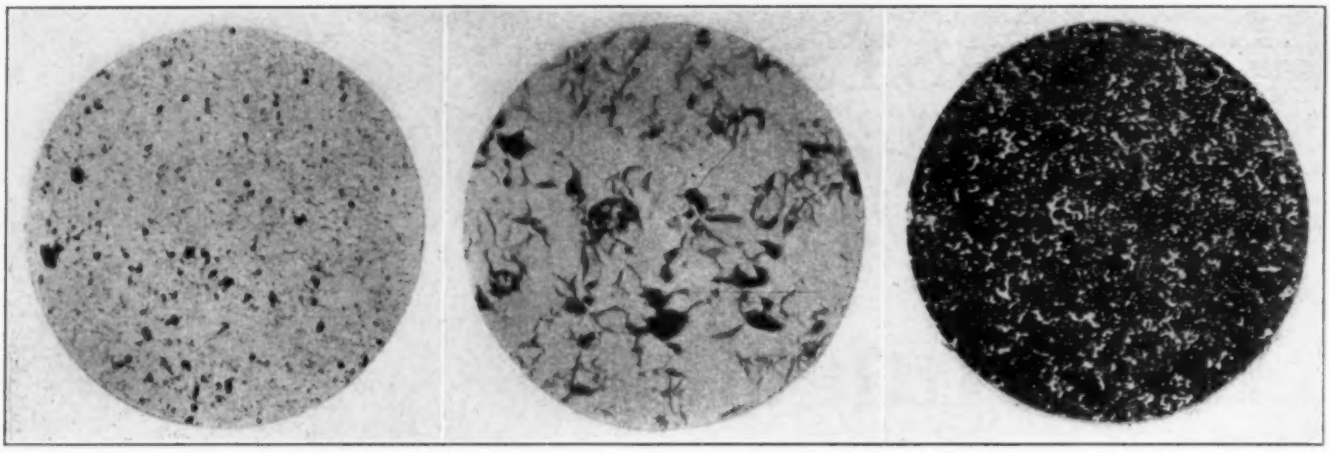


FIG. 4—SAMPLE FROM CENTRIFUGAL PIPE, NOT ETCHED X 100. FIG. 5—CENTRIFUGAL PIPE NOT ETCHED X 100. FIG. 6—CENTRIFUGAL PIPE ETCHED X 100

oil under pressure are available where needed all through the building. All operations follow each other in natural sequence with the result that production is maintained at the peak of efficiency.

Three cupolas are available, each one capable of melting 5 tons per hour. Two are operated regularly while the third is kept for reserve. The molten metal is carried rapidly from the cupolas to the different casting machines by an electrically operated monorail.

Have Various Sizes

The casting machines are set up in pairs and their range is as follows: 3 machines are suitable for pipes of diameters of 80 to 220 millimeters (3.14 to 8.66 inches), 3 machines are suitable for pipes of diameters 200 to 500 millimeters (7.87 to 19.18 inches), 1 machine is suitable for pipes of diameters 400 to 1000 millimeters (17.74 to 39.37 inches).

Each machine covers a wide range of diameters and lengths. Changing over from one diameter to another and the complete setting up of the machine can be accomplished in about half an hour. Pipes can be cast any length from 7.5 meters (24.60 feet) down, according to the requirements of the customer, provided the order for each length is sufficiently large to warrant a deviation from the regular standards. The casting machine consists essentially of a long bottom frame designed to carry a special truck mechanically driven by an electric motor through reduction gears that permit a quick speed variation.

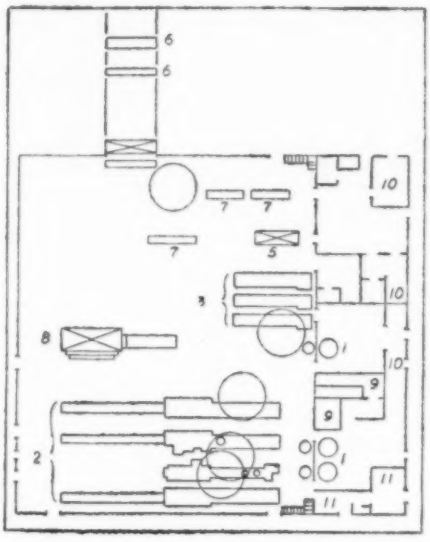


FIG. 7—FLOOR PLAN OF FOUNDRY SHOWING: 1, CUPOLAS, 2, AND 3, CASTING MACHINES, 4 AND 5, TAR COATING MACHINES, 6 AND 7, HYDRAULIC PRESSES, 8 MACHINE FOR TURNING MOLDS, 9, CORE OVENS, 10, REFRACTORIES PREPARATION, 11, OFFICE

Outlines Process

A trough internally lined with refractory forms hangs over the end of this truck. The trough moves horizontally inside the rotating metal mold and pours into it the molten metal in the exact quantity delivered by the pouring ladle. This pouring ladle is tipped by an electric motor through proper reduction gears and is made of such a shape that the quantity of metal delivered in the trough during each unit of time remains constant. Through the properly designed gear changes the quantity of metal poured can be proportioned quickly and easily to the various diameters and thicknesses of the pipes.

The rotating metal molds made of special iron cast in a peculiar way, rest on a number of cast iron rolls carried on two longitudinal shafts driven electrically through a suitable reduction gear train. The revolving speed of the cast iron forms varies from 150 to 1300 revolutions per min-

FIG. 8—CENTRIFUGAL PIPE ETCHED X 100. FIG. 9—SAND CAST SPECIMEN NOT ETCHED X 100. FIG. 10—SAND CAST SPECIMEN NOT ETCHED X 400

ute according to the diameters of the pipes to be cast. A suitable rotating speed of the flask, a suitable horizontal speed for the trough, and a suitable quantity of molten metal to be poured have been established for each diameter and for each thickness of pipe.

These three factors are bound together by rigid laws. Once they are exactly determined they maintain their reciprocal interdependence through a perfect synchronism that will not be altered in the least by eventual variations in the characteristics of the electric energy. This guarantees uniformity of product. One attendant has control of the different movements from one central platform through the easy turning of a handwheel.

The rotating metal mold is protected with a sheet steel cover. Perforated pipes spray the outside surface of the hot mold and carry away from it just enough heat to keep the mold at the correct temperature for making the casting.

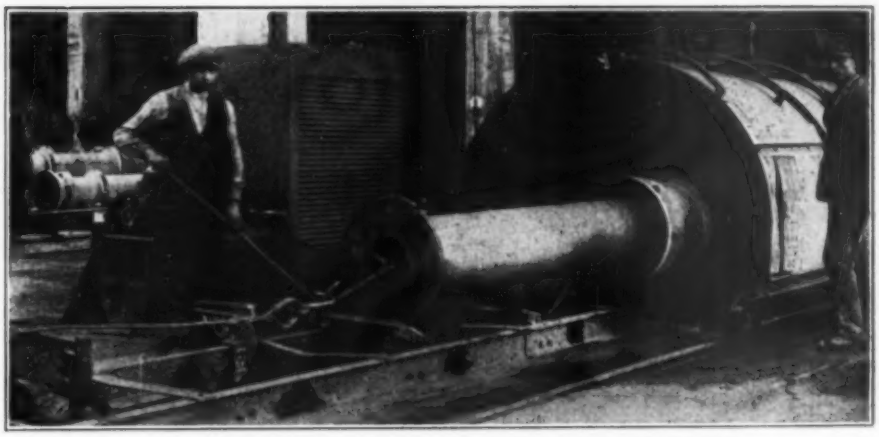


FIG. 12—REMOVING CASTING FROM ONE OF THE MOLDS

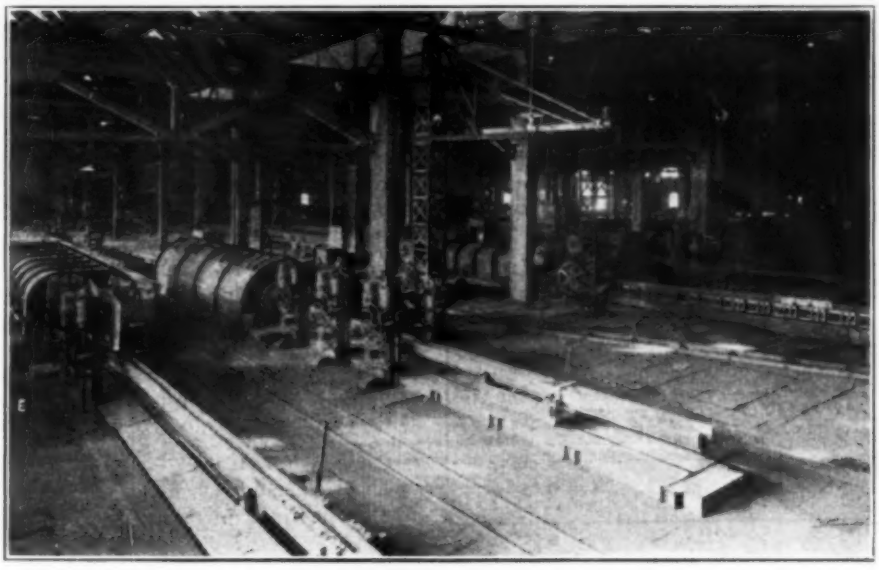


FIG. 11—GENERAL VIEW OF CASTING MACHINES.

The casting operation proper is accomplished in less than 18 seconds, but the rotation of the mold is continued until the iron has solidified. The pipe then is allowed to cool in the mold until it has reached the right temperature, when it is pulled out by a special automatic truck and transported to the successive finishing operations.

A serial number is assigned to each pipe. The castings are weighed, inspected for thickness and surface defects. While still hot they are tar coated in a dipping tub by an automatic mechanism. The pipe is dipped horizontally and then lifted out at sufficient angle to allow the surplus coating to drain off before it has hardened thus insuring an even coating.

Each pipe is subjected to a hydrostatic pressure test. Machines for applying this test are installed at convenient places throughout the mill. The amount of pressure applied depends on the use to which the pipe is to be put, and usually equals one and one half the working pressure. After the hydraulic test the pipe again is weighed and then sent to the stock yard for shipment.

The production cycle is arranged in such a way that within 30 minutes from the time the molten metal leaves the cupola the pipe is finished, inspected and placed in the stock yard. The yard is furnished with standard and narrow gage tracks and handling cranes to facilitate loading and shipping operations.

Small Losses

Present mill installations, it is claimed, are amply sufficient for a monthly production of 2000 tons with one-third the amount of labor that would be required for turning out the same tonnage of pipes in sand molds cast vertically. In the Franchi-Gregorini process the labor cost amounts to only 13 to 15 per cent and the overall efficiency of the plant is given as about 90 per cent. Every 100 kilos of iron charged in the cupola yields 90 kilos of good pipe. The 10 per cent includes all losses pertaining to the process from melting loss to defective pipes.

The pipes present a smooth even surface on the inside without flaws or imperfections, and a uniform thick-

FIG. 13—STOCKYARD SHOWING THE FOUNDRY IN THE BACKGROUND

ness throughout. A fresh fracture shows a fine structural grain, a silky soft appearance, entirely free from slag, cold spots or blow holes, without flaws or imperfections of any description whatsoever.

The average chemical analysis shows following composition:

T.C.	Si	Mn	Ph	S
3.27	2.85	0.45	0.75	0.08

The combined carbon varies through the process of casting in a hot metal mold, according to the diameters and the thicknesses. It varies from a minimum of 0.15 per cent to a maximum of 0.50 per cent. With the 0.15 per cent content there is a matrix eminently ferritic, while with a maximum of 0.50 per cent carbon there is still nearly 24 per cent in volume of free ferrite. The average chemical analysis and maximum carbon content are shown in the accompanying table.

Even with the maximum content of combined carbon, the amount of free ferrite is only about one-quarter in volume, while usually in sand cast pipes ferrite is lacking and pearlite predominates. This would seem to infer greater resistance to acid reaction.

Compare Samples

The Franchi-Gregorini centrifugal pipe has only about one-half the amount of combined carbon as compared with pipes vertically cast in sand, and less than one-half in phosphorus, from which it follows that its brittleness is greatly reduced. This may be noted in several accompanying micrographs magnified 100 and 400 times, etched and not etched, all corresponding to the chemical analysis given, and also micrographs of the same iron only cast in sand in the form of a test bar 25 millimeters (1 inch) in diameter.

The micrograph shown in Fig. 4 of a centrifugal pipe, not etched, magnified 100 times, showing clearly the fine grain and special structure of graphite, may be compared with the micrograph in Fig. 9 taken from a sand cast specimen. The same difference, only more pronounced, may be observed from a comparison of Fig. 5 with Fig. 10. The etched micrographs show clearly the even distribution of pearlite and ferrite, and the phosphorus eutectoid in the centrifugally cast pipe.

The tensile strength obtained from test specimen cut from pipes has an average value of 21 kilogram per millimeters^2 (30,000 pounds per square inch) with a minimum of 17 kilogram per millimeters^2 (24,000 pounds per square inch) and a maximum of 25 kilogram per millimeters^2 (35,000 pounds per square inch).

A series of tensile tests on pipes of 100 millimeter, 200 millimeter, and 300 millimeter diameters (4, 5, and 12 inches) gave an average ultimate tensile strength of 32,900 pounds per square inch (23.1 kilogram per millimeters^2) with a maximum of 39,300 pounds per square inch (27.6 kilogram per millimeters^2) and a minimum of 28,700 pounds per square inch (20.1 kilogram per millimeters^2).

Static bending strength on specimen obtained from the pipe wall of 25 millimeters by 10 millimeters (1 x 0.39 inch) and with an unsupported span of 305 millimeters (12 inches) has an average value of 42 kilogram per millimeters^2 (60,000 pounds per square inch) while for cast iron poured in sand the value varies from 25 to 28 kilogram per millimeters^2 (35,500 to 40,000 pounds per square inch).

Hardness of the centrifugal pipes is not greater than that of the annealed pipes. In fact the average values go from 25 to 35 degrees shore corresponding to nearly 140 to 200 brinell, according to the various diameters.

The iron can be machined easily, drilled, cut with hand saw or chisel; in other words with the common tools used in the installation of cast iron pipes.

The slightly greater hardness of the centrifugal pipes as compared with the sand-cast pipe is due not to a high combined carbon content which on the contrary is less than in sand-cast pipes (for centrifugal pipes the combined carbon varies from 0.15 per cent to 0.50 per cent, while for sand-cast pipes it varies from 0.45 per cent to 0.95 per cent) but to a fine grain and to the more uniform and compact structure shown by the greater tensile strength which the centrifugally cast pipe specimen show.

Average Chemical Analysis

	Per cent in weight
Carbide of iron, Fe_3C	7.48
Graphitic carbon, C	2.77
Carbide of Manganese, Mn_3C	0.34
Phosphide of Iron, Fe_3P	4.80
Sulphide of Manganese, MnS	0.21
FeSi	8.43
Resultant iron, Fe	75.97
	100.00

	Per cent in volume
Pearlite	57.30
Graphite	9.00
Steardite (Eut. Ph.)	9.37
Sulphide of manganese	0.42
Resultant free silico ferrite	23.91
	100.00

Dual Service Performed

(*Concluded from Page* 738)

hidden flaw. The company has been making these castings for a number of years and never has had one fail under service.

The company employs approximately 400 men. The laboratory force comprises two shifts of eleven men each who carry on all routine and control all analyses, physical testing and supervision of melting, pouring inspection and heat treating. A number of part-time apprentices are employed in co-operation with other local manufacturers.

The variety that characterizes the work of this interesting jobbing foundry may be judged from an enumeration of a few of the castings made. These include lamp posts with fire alarm or police signal boxes; castings for fish freezers; a great multiplicity of navy direction finding radio apparatus and miscellaneous truck castings. A complete cowl for buses and a tank top for a heavy truck as well as cylinder heads and crank cases for eastern automobile manufacturers give an idea of the automotive work handled by this foundry. Cylinder heads for airplane engines previously have been mentioned. One type of airplane engine requires more than 50 parts of cast aluminum including nine of the cylinder heads and three large body castings.

The shoe industry depends upon aluminum castings in many lines. Large pattern frames over which leather is cut are cast in aluminum. Similarly, a flat plate cut by many vertical slots is used to supply glue for pasting in insoles on high production work. Shoe lasts at one time were made of aluminum, and practically all types of rubber footwear are molded over aluminum forms. Miscellaneous hardware including frames for spirit levels, trysquares and other sundries employ aluminum. A complete cover to silence a well-known typewriter is a regular run job. Wheels for undertakers' buggies and grave markers give a finality to the miscellaneous character of this company's work although further enumeration might include ice scrapers, golf club heads, motorcycle parts, gelatine boxes, dryers for radiator cores and many others.

The advisory staff, in addition to Mr. Becker, the manager, and Mr. Seiser, the foundry superintendent, includes H. R. Doswell, in charge of the technical division; W. J. Granville, production manager; and G. A. Lewis, in charge of inspection department.

Bill Has an Inquiry on Lamp Standards

By Pat Dwyer

HOW do you suppose," Bill inquired the other night, "How do you suppose these here now movie magnates and movie magnasites—if that is the proper feminine form for the female of the species—how do you suppose these birds find time to answer a few thousand letters each day?"

"What's to stop them?" I parried carelessly. "What's to stop them if they feel in the proper mood?"

"What's to stop 'em?" Bill asked incredulously and with a steadily rising inflection. "Could you do it?"

"No," I admitted, "I could not do it, but I fail to see what bearing that fact has on the argument. I am not a movie star—worse luck—and I do not receive several thousand letters daily. Candor and a strict regard for the truth compels me to admit that on some days I do not receive even a single letter. If you cannot sleep at night on account of worrying over the puzzle, why do you not write to one of these nimble fingered lads and ask him how he does it?"

"Who said I was losing sleep over the thing?" Bill asked indignantly. "I ask you a civil question and instead of giving me a simple and civil answer, you ignore the point of the question and deliberately attempt to force me into a false position. Have a care Squire Turkeyfoot, some day the worm will turn and nip you in the bud!" "Nip away, my lad," I responded easily. "I have been nipped before by better nippers than you and they all died in great agony. I don't mind telling you, confidentially, that my favorite indoor sport is nipping the nipper. Some day when I have the time I shall take great pleasure in showing you my private collection of nipper scalps spiked to the old red barn door. In my young and lusty prime I thought nothing of collecting half a dozen of these trophies—" "Yeah," Bill interrupted rudely. "You and who else? Cut out the baloney. The only collection you ever made is a collection of excuses for not giving any person a direct answer. If I were to ask you this minute who made the world you probably would begin by assuring me that you had nothing to do with the job. Then you would branch out in a long rigmarole on the relative values of concrete and steel as building materials and end up by asking me some silly question like why I wear a dip instead of a soft hat."

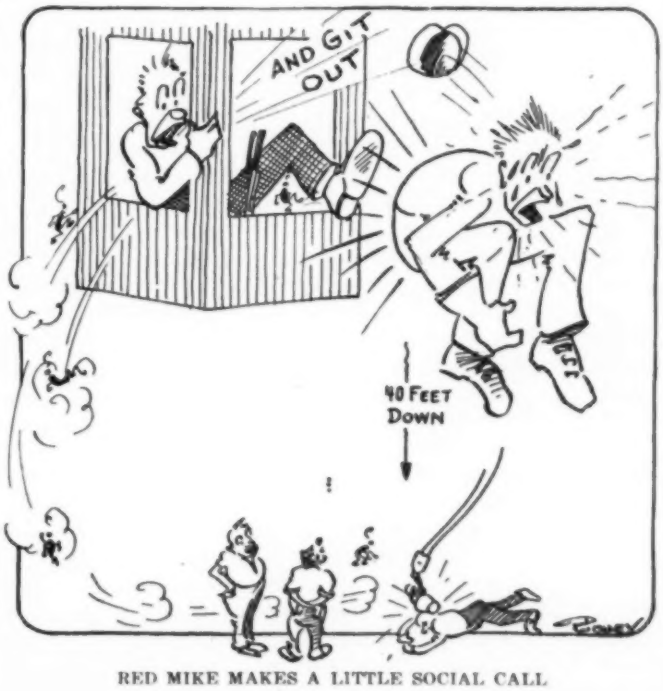
"Well," I said, "that is an idea. Why do you wear a dip?"

"Har, har!" Bill grinned in high good humor. "I did not think I could catch you on that old one. Why do I wear a dip, Mr. Bones? Well, Mr. Bones Ah'll tell ya why Ah wea'hs a dip. Ah wea'hs a dip Mr. Bones to covah ma haid!

"However, to come back to the original point, how do you suppose any human being can answer hundreds and hundreds of letters every day for months and years on end?"

"Bill," I replied earnestly, "you know me, a plain blunt man, a man of few words. The ability to write thousands of letters daily, also the ability to attract thousands of letters from the great open spaces is one of the closely guarded secrets of the actor's profession. It is known only to the shy and shrinking press agent and neither rack and thumb screw nor oxen and wain ropes would induce him to tell—in less than 1000 words in preferred space next to pure reading matter. Why do you care how it is done?"

"Well," said Bill, "I'll tell you. Once in a while I get a letter from an old pal here or there and I find that the whole evening is shot to pieces before I finish writing a reply. If I meet a man, I can talk to him without any trouble, but the minute I sit down with a pen, a bottle of ink and a sheet of paper, the old mental engine stalls and I can't get more than a few feeble kicks out of it." "How about the letters you write now and again to men who submit foundry problems for your consideration?" I asked him. "If an ordinary friendly letter to a man you know, occupies your time for an entire evening, one of these long technical compositions addressed to a total stranger must set you back about a week." "Oh," he replied, "that is a different proposition altogether. No imagination required in answering a definite question. I go over to the master mechanic's office and talk to little Dolly Varden as if she was the man who asked the question. She takes all I have to say in a few min-



RED MIKE MAKES A LITTLE SOCIAL CALL

utes. Later in the day she brings me a beautifully typed copy with comas and periods and things spaced through it here and there all ship shape and Bristol fashion. All I have to do is sign my name and the job is done.

"Here," he continued, dragging several sheets of paper out of his pocket, "here are two letters I received the other day which show how the system works out. The first is from an old friend. If I met him face to face I could comment on it readily, but I gnawed about 1¾ inches from the end of a pen holder last night and spoiled three sheets of the Missis' scented paper before I finished a letter to him and then I was not satisfied with the job. It was full of jumps and jerks like a—a—like a hop toad with the toothache. I won't inflict the answer on you, but here is the letter and the sketch which accompanied it.

Dear Bill: While poking through a drawer in my desk the other day looking for some data on a certain subject I found the attached sketch. It hits off conditions in the averaging jobbing shop so shrewdly and accurately that I know you will appreciate it as an addition to your collection. It is the work of a lad I had on one of my cranes for a few months. He was an electrician by trade and I guess this drop in his social position kinda soured his disposition. He was a little queer, anyway. Personally I liked him very well. He was exceptionally keen and bright, a regular wizard on the job, but he had a temper like that of a cross between a circular saw and a wild cat steeped in moonshine and sheep dip.

He was full of little playful tricks. If he did not like a molder he would hit him on the head with the block in passing. He thought nothing of hitting him a bang with a ladle or an empty flask. He could lower a cope as gently as the falling dew from heaven, or he could drop it like a chimney pot on a windy night. In his swift and nimble hands, the crane became a living entity with the strength of a giant, the smoothness and speed of a greyhound, the gentleness of a baby and the accuracy of a micrometer. He was a darb!

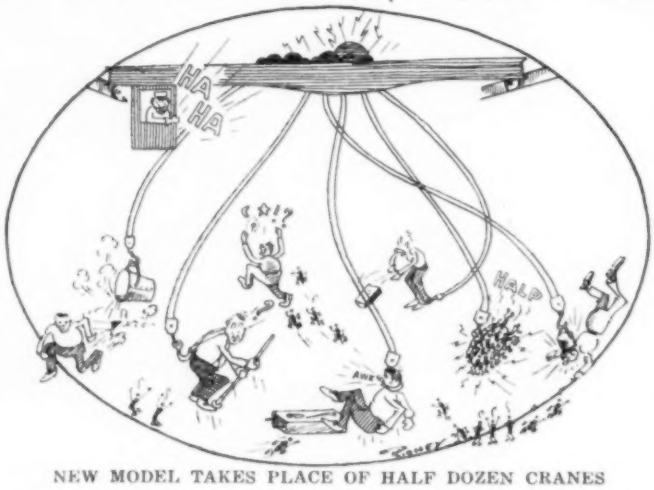
However, I had to listen to so many complaints against him that I had to let him go. We have a safety committee for examining the equipment and for enforcing the rules of safety and naturally this craneman was in a jam with them all the time. Boy! He certainly loved 'em. One morning he handed me the attached sketch with the cynical comment that perhaps a system of that kind might suit the knockers and kickers. You will note he had a rather droll sense of humor.

"Very embarrassing," I admitted, "to have a playful lad like that cutting up his merry pranks."

"'Twould be embarrassing for him," Bill agreed, "if he tried to work any of his tantrums on some of the boys of the old brigade. Do you remember Red Mike? Mike climbed up a column one day and threw the craneman out of his nest because, forsooth, the craneman had ignored his lusty bellow for a lift and had attended to another molder first. He was not working piece work and he was in no particular hurry with his work, but he claimed that in the interests iv discipline and fair daylin', that moonky in a cage had to be larned not to play no favrits! Another time—"

"Never mind the other time," I interrupted. "What's in the other letter?"

"The other letter is from a man who wanted some dope on lamp posts.



NEW MODEL TAKES PLACE OF HALF DOZEN CRANES

He wrote that he was planning on a small scale to make ornamental lamp posts and he wanted me to describe the commonly used methods for coring this class of castings. Also he wanted a suitable analysis for the iron.

"I wrote him that several methods are available for making cores for the castings to which he referred. The choice of methods adopted depends to a great extent upon the number to be made each day. In his particular case where presumably he only intends to make two or three for each heat, the best method probably is the one that costs the least for equipment, viz: a single wood pattern split longitudinally in the center and a single half corebox, also made of wood. This method is not special, but is the method usually employed for making castings of a similar character in small numbers in jobbing foundries.

The half core is reinforced with several rods or pipes, or with one large rod or pipe, depending upon the diameter of the core. It is turned out on a plate and dried. Under ordinary conditions, two half cores are made at one time and after they are dried they are rubbed to a bearing, then pasted and wired together.

Where the core room and oven space is limited, it it advisable sometimes to make several half cores and dry them one day. On the following day the half corebox is filled with rammed sand and then one of the dried half cores is placed upon the green sand in the box, with a slight layer of paste between. The entire assembly is rolled over and the half corebox is removed. This procedure is repeated until all the dried half cores have been utilized. The combinations, half dried and half green cores, are returned to the oven until the upper halves have dried. Then they are taken out.

Usually this method produces a tighter joint than where the two halves are pasted dry. Also, the core is more apt to be truly round when made in this manner. Another advantage of this method is that usually no rods are required in the upper half of the core. If no rods are placed in the upper half of the core, this side should be marked in a suitable manner to prevent the molder from reversing its position in the mold. Where the core is exceedingly long and slim, rods are required in both halves, otherwise the core will bend in the center, unless handled in an exceedingly careful manner. A bend in the core may cause it to spring at the joint and form a thin fissure through which the iron may leak into the vent and thus produce a scrap casting.

Needless to say the core must be made from a free venting mixture. Clean sharp sand bonded with oil or any other good binder will produce the best cores, but usually it is customary to add from 10 to 20 per cent molding sand to the mixture. The molding sand reduces the permeability, but it helps the core to maintain its shape during the drying period. The sand must not be rammed too hard and the bonding material must be held to a minimum, otherwise the hard core will not permit the metal to lie against it quietly. The result will be blisters, part or all the way through the top of the casting.

A generous, continuous vent channel should be cut in the joint face of each half core before they are pasted together. This precaution not only will insure a free vent, but will prove of material assistance in re-

moving the core from the casting later. In a hollow core, combustion takes place inside and outside with the result that the bonding material is burned completely and the spent sand will run out of the casting readily.

The most important feature to be observed in making these castings is to provide adequate equipment for holding the core rigidly in the center of the mold. The prints at the ends should fit snugly. Shaving the prints, or the application of clay or dough worms should not be allowed.

Instead of placing the usual prints on the ends of the pattern, the diameter of the core, they should be made the full size of the pattern. Suitable provision is made in the ends of the corebox for the extremities of the core for a distance of at least 5 inches, to fill these special core prints in the mold. In this manner the core *stops itself off* at each end. Where the core is an especially tight fit, this precaution will prevent a crush. This style of core print will produce a cleaner and more uniform end on the casting, than the style usually employed. One or two chaplets are required in the drag to prevent the core from sagging in the center under its own weight. Two or possibly three chaplets are required in the cope to prevent the core from springing upward under the pressure of the molten iron. The core must be clasped firmly at both ends and the cope chaplets must be spaced approximately 3 feet apart. Thus on a 10-foot casting, one chaplet probably will be sufficient on the bottom and two will suffice on the top.

If the core is not held rigidly by the ends and by the chaplets, it will spring in the center and the casting thickness will not be uniform. The thin section will contract first and the resulting casting instead of being straight, will be bowed to a greater or lesser extent.

This feature frequently is overlooked and foundrymen blame the iron, the gates, the core, the sand, the style of flask, or possibly the manner of shaking the casting out of the sand for crooked castings. One or all of these factors may be responsible, but in the great majority of cases the trouble is due to uneven thickness of metal caused by a shift in the position of the core during the period required to fill the mold.

The procedure in making these cores and castings does not differ in any material respect from ordinary foundry practice. Where they are made in large quantities metal patterns and coreboxes are mounted on molding machines. The pattern is lowered part way through a suitable stripping plate before the half mold is removed. In the event he might be interested in short cut methods practised where the castings are made on a production basis, the following brief outline might suggest a few points that may be incorporated with advantage even in making a limited number.

Cast iron, cast steel, or steel plate flasks are employed. Wood flasks possess the advantage of lightness, but where adequate crane service is available, this factor is of minor importance. Disadvantage of a wood flask is that it is not sufficiently rigid unless it is braced in the center with clamps on the outside, with bolts extending from side to side, or with cast iron bars bolted to the sides and with suitable gaps in the center for the casting.

HE WHISTLED IT ON TUES. THURS. AND SAT.

Where iron flasks are employed, both cope and drag are barred and therefore the time and trouble of adjusting a bottom plate is eliminated. Also, generally speaking, the vent escapes more readily from a barred drag than it does from one on which a bottom plate is clamped. Another advantage of the iron flask is that the ends are cut out the neat size of the core ends and certain bars in the cope and drag are fitted to hold the chaplets.

With a wood flask it is necessary to use long pointed chaplets driven into the bottom board. Long chaplets in the cope are held down by flat steel or iron bars laid on top of the cope and gripped at either end by the clamps that hold the cope in place on the drag. Neatly fitting stud chaplets in the iron flask, save time and eliminate the necessity of chipping after the casting is poured. They can be secured in any size from supply houses.

A row of pencil gates, or, several *wedge* gates on top are preferable to the usual long gate with many branches at both sides of the mold at the joint. They insure better distribution of the iron. They are removed more easily and they do not impose so severe a strain on the mold during the pouring operation. Incidentally they permit the use of a much narrower flask with consequent saving in the amount of sand and in the ramming time in the event the sand is rammed by hand. Suitable analysis for castings of this character follows: Silicon 2.00-2.25 per cent, sulphur under 0.10 per cent, phosphorus over 0.50 per cent, manganese 0.40-0.60 per cent. The sulphur and phosphorus are practically negligible factors so far as the utility of these castings is concerned and may vary widely from the percentage indicated. Satisfactory castings may be made from a mixture of one-third foundry pig, one-third stove plate scrap and one-third good machinery scrap. "Your method," I said, "reminds me of the story of the illiterate old colored gentleman who was asked if he could sign his name. 'Suttinly, suh!' he replied. 'Suttinly Ah kin sign ma name if Ah wants to, but Ah neveh wants to. Ah dictates it, suh! Ah dictates it!'"

Cancel Convention Plans

Board of administration of the Ohio Foundries association, Inc., has abandoned its plans for the annual convention of the society which was to be in the form of a boat trip on the Ohio river. The board has decided to hold four sectional meetings in various parts of the state at different times during the year. Luncheon, speakers and round table discussion will feature these proposed meetings. It is thought that in this manner a larger number of foundrymen will derive the benefits of the association. The first of these meetings will be held at Toledo, O., the latter part of September or early October.

Pouring Height Should Be Low

(*Concluded from Page* 756)

worse than castings gated in either of the other two ways. With low pouring heights, there is but little difference between castings gated in this way and castings gated as in *B*, Fig. 8.

The only variable which was changed in the case of the slabs shown in Figs. 2, 5, and 9 was pouring temperature. The castings depicted in these radiographs were gated and poured in the same manner as were the castings shown in Figs. 1, 4, and 7, but at a temperaure of 1400 degrees Fahr. Considering only trapped gases, these slabs are more sound than those poured at 1250 degrees Fahr. The metal is more fluid, and takes longer to solidify. This means that the mold gases and the air sucked in through the sprue have a better chance to escape. Pouring at 1500 degrees Fahr. is even better from this standpoint, as the radiographs in Fig. 6 indicate.

It must be remembered that on increasing the pouring temperature there is a corresponding increase in the grain size of the casting, and a greater tendency for shrinks and draws as shown by Bossert, *Transactions*, American Foundrymen's association, 1928. This tendency is apparent in the X-ray negatives of castings poured at the higher temperatures. It is difficult to reproduce fully all the details of an X-ray negative by means of a print, and the tendency for shrinks and draws does not stand out clearly in the radiographs. While more or less of the trapped air may be liberated, the physical properties are decreased due to the increased grain size and the increased tendency for shrinks and draws. As the pouring temperature is raised, the chances for oxidation are increased. A close examination of Fig. 6 will show that the principal defect outside of shrinks and draws is dross.

Slight Differences Exist

A comparison of the slabs in Figs. 2, 5, and 9, with respect to gating, indicates that only slight differences exist in castings poured from the low height. Possibly the slab in Fig. 5 is a little better than the other two. The small differences occurring in these slabs clearly show that more of the mold gas can escape at the higher pouring temperatures.

From an examination of the slabs poured 12 inches above the top of the sprue, the casting shown in Fig. 9 is the worst and the casting shown in Fig. 5 the best. The castings poured at 1250 degrees Fahr. showed the same differences with respect to gating. This further indicates that in the case of the greater pouring heights, the principal defects are due to agitation and to air being sucked into the pattern cavity.

In the castings shown in Figs. 1, 2, 4, 5, 6, 7, and 9, the runners leading into the pattern cavity were of the same thickness as the castings. To partially overcome the detrimental effects of increased pouring height, the thickness of the runners at the point of contact with the pattern cavity was cut to 1/16-inch.

Poured High

The castings were poured at 1250 degrees Fahr. from a height of 12 inches. In all cases the sprues were kept filled. The radiograph in Fig. 10 is from a slab gated as in *C*, Fig. 8 with the runner choked. This may be compared with the radiograph at the bottom of Fig. 7 which is gated and poured at the same temperature without choking the gate. From these radiographs, it is evident that the deleterious effect of high pouring is overcome partially by choking the runners. Castings gated as in *A* and *B*, Fig. 8 showed similar results. While the effect of pouring from any appreciable height may be overcome partially by choking the runners, chokes in the runners do not warrant the pouring of a casting at an excessive height.

In pouring all of the castings thus far described, the sprue was kept filled throughout the pouring operation. That this practice should be followed at all times is clearly demonstrated by the radiographs in Fig. 11. The casting at the left was gated as in *A*, Fig. 8, and poured so slowly that the sprue could not be kept filled, while the casting at the right was gated in the same manner, and poured at a rate which kept the sprue filled at all times. Both castings were poured at 1250 degrees Fahr. from a height of 12 inches.

The results are obvious, and clearly show the advantages to be gained by keeping the sprue filled. The effect is magnified at the higher pouring heights, since there is a greater tendency for agitation and for sucking air into the sprue, but it holds for all pouring heights. Merely choking the sprue is not enough to insure a good casting, but choking the sprue improves the quality of the casting, and should be made a standard practice in the pouring of aluminum and aluminum alloys.

The following general conclusions may be drawn as a result of the work discussed in this article:

If the best results are to be realized, aluminum or aluminum alloy castings always should be poured from the lowest possible height regardless of the manner in which they are gated.

With excessive pouring heights, the metal becomes agitated and dross inclusions are likely to occur in the castings.

More air is sucked in through the sprue when the casting is poured from an appreciable height. This may become trapped within the mold.

Even though the casting is poured with the ladle held close to the sprue, it may be defective unless properly gated.

Choking the sprue during pouring, and placing chokes in the runners leading into the pattern cavity, partially overcome the deleterious effects of pouring a casting from an excessive height. These should serve as means of further improving the quality of the casting rather than of justifying excessive pouring heights.

Pouring height is related in a way to pouring temperature. While certain variations in pouring height may be taken with some pouring temperatures and not with others, the soundest casting always results when it is poured from a lower height.

Lowers Core Strength

(*Concluded from Page* 734)

and its moisture content. It is also believed that other binders, such as rosin, flour, and molasses, would show even greater loss in strength than baked core oil. It has been suggested to add some material to the core sand mixture to make the core oil impervious to moisture.

The result of doing this would be to reduce the porosity of the core and permit of a large percentage of surface moisture to collect on cores. In other words, the core, if impervious, would act somewhat like a metal chill does in a mold. A quantity of steam would be produced which would result in gas pocketing. Obviously the remedy lies in the simple fact that molds containing cores should be poured immediately after closing or more core oil should be added to the core sand mixture to compensate for the 50 per cent decrease in strength. The latter procedure would, of course, produce more core gases than before and ample venting of both mold and core would be necessary to produce good castings with maximum soundness.

When He Wants *Facts* He Digs Them Out *Himself*

JOHN SHAW, genial, tactful, dignified, energetic and one of the most eminent members of the Institute of British Foundrymen, an association than which there is none more eminent, presents another shining example, if indeed further illustration is needed, of the truth of the good old British proverb: "As the twig is bent, the tree is inclined."

John's father was a molder. To the idle and thoughtless, probably this is sufficient reason why the son also should learn the trade. Cynical individuals are not wanting, who will claim that fact should be sufficient reason for the boy taking up any other—yes, ANY OTHER—line of endeavor in preference to the foundry. These cynical lads also can quote a proverb or two if pushed into a corner. It's all fine (they will say) to prate about the bent twig, but (they will insinuate darkly) didja ever hear the proverb about "once bitten, twice shy" or the burnt child who dreads the fire.

Proverb or no proverb, this particular twig entered the foundry of the Widness Foundry Co., which as all the world knows is at Widness, at an early age and applied himself so diligently to the job of absorbing all the available knowledge that he was appointed assistant foreman at the age of 19.

In an emergency he has operated the cupola, made patterns, had a go at the lathe in the machine shop and fired the boiler. On one memorable occasion he jumped too far and only escaped by virtue of the fact that his body still retained some of the slimness of youth and therefore was more amenable to the extrusion process than it was in later years when it had taken on more dignified curves.

Anxious to observe the effect of some chemical on the scale in the boiler recently blown down for inspection, he crept in through the manhole. The temperature inside the boiler was a little less than that required to boil water at sea level, say about 210 or 211 degrees Fahr. The amateur investigator soon was more anxious to get out than he had been to get in, but was horrified to discover that apparently owing to one of the well known laws if nature, he had expanded to a degree that effectually blocked his egress. Only after he had discarded all covering except his boots, was he able to claw his way to safety in the open air.

Unlike the majority of notable people, he kept no diary. If he *had* kept a diary on the date which marks this entry we should find the inevitable *N. B.*, without which no diarist can finish a page. In this instance the *N. B.* probably would read: *Examined boiler today. Never again! Next time send boy or thin man not to weigh over 6 stone.*

When the Institute of British Foundrymen was established in 1904, several of the papers dealt with the then new microscopic examination of cast iron. Most of this fine stuff went over John's head—for a short time. He promptly enrolled in a technical school for a full four-year course in iron and steel manufacture, also theoretical and practical metallurgy. The practical metallurgical course entailed attendance at a laboratory 10 miles from his home, but every Saturday afternoon during the session he was Johnny-on-the-spot from 3 to 10 p. m. He graduated with honors in all his subjects—and *then* he joined the Institute of British Foundrymen, fully prepared to enter the arena and splinter a friendly lance with any author, any time, on any phase of the foundry industry. Also he became in turn foundry manager for Cochrane & Co., Ltd., Dudley, director of the gray iron casting section, ministry of munitions during the war, and for several years before his recent retirement, manager of the Newhall Works, Brightside Foundry & Engineering Co., Ltd., Sheffield.

With a view to expanding his field of knowledge and usefulness and incidentally of affording him an opportunity of taking part as a duly qualified member in any little bickering on this side of the ocean, he joined the American Foundrymen's association in 1910. At the International Foundry congress in Detroit in the fall of 1926 he was presented with the John A. Penton gold medal of the American Foundrymen's association for distinguished contribution to the art and science of founding. The following year he presented the annual British exchange paper at the Philadelphia convention.

In opposition to the saying that a prophet is not without honor save in his own country, it may be pertinent to note at this point while talking about medals and so forth, that he was presented with the Oliver Stubbs gold medal at the 1924 meeting of the Institute of British Foundrymen as a tribute to his distinctive and valuable services to the foundry industry.

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¶ Need Uniform Brass Ingots

BRASS foundrymen making castings for special service are at the mercy of the firms supplying them with ingot metal. When a customer demands castings made within certain tolerances as to the proportion of copper, lead, zinc and tin or other elements, the foundryman must depend, in making his mixtures, upon the word of the firm supplying him with ingot metal. His furnace charge is computed upon the analyses supplied with the metal which he buys. Accordingly, if the manufacturer of ingots does *not* adhere to his analysis through accident or design, the foundryman suffers loss through rejection of the castings.

RECENTLY a western foundry made a comparatively large order of small castings for an artificial silk mill. The requirements of the user, as stipulated in the foundryman's contract, called for a minimum limit on zinc. When the castings were completed the customer rejected them on analysis as being too high in zinc, and check analyses demonstrated that the customer was right. Should not the foundryman be reimbursed by the ingot producers for this loss? Further, should not some method be devised by ingot producers to guarantee the product which they sell to foundries to be exactly as represented? Ingot producers now have a trade association which should consider this problem and be responsible for their membership in guaranteeing adherence to standards. This might serve to obviate the necessity for "pure food" action on the part of brass foundrymen.

¶ Iron Output Up

RECENT statistical reports of the American Iron and Steel institute on pig iron production for the first half of 1929 show increases over that produced in the first half of 1928 and the second half of the same year, except in one division. The figures compared are those which are related to the foundry industry and include bessemer and low phosphorus, foundry, and malleable pig irons. In the first half of 1929, 4,944,457 tons of bessemer and low phosphorus pig iron was produced. This is an increase of about 10.9 and 8.5 per cent over that for the first and second halves of 1928 respectively.

PRODUCTION of foundry pig iron was 2,111,170 tons, or an increase of 0.27 and 0.32 per cent above the first and second halves respectively of 1928. Malleable pig iron production was 1,274,300 tons or an increase of 34.5 and 30.5 per cent above the first and second halves respectively of 1928. Production of charcoal pig iron was 67,504 tons, or a decrease of 17.2 per cent below that in the first half of 1928, and an increase of 5.7 per cent for the second half of 1928. Comparison of the various grades of pig iron for sale in the first half of 1929 shows an increase in all departments over that for the first half of 1928. Bessemer and low phosphorus pig iron production was 239,976 tons, or an increase of 5.7 per cent. Production of foundry pig iron was 1,958,718 tons, or an increase of 3.0 per cent. Malleable pig iron production made great strides and the figures for the first half of 1929 show 1,153,818 tons were produced or an increase of 36.6 per cent above that for the first half of 1928.

¶ Who Loves a Stowaway?

SELFISH personal considerations governed those who have beaten their way without dole of cash or services across the far reaches of the world, since the trackless ways of the sea first were conquered by man. Free transportation, the greener fields of far countries, escape from laws or military service and now the blaze of cheap publicity have furnished the immediate lure of purely personal gain which tempted the unbidden guest to steal his passage. Who has profited, ever, but the stowaway and always at the expense of the one he cheats.

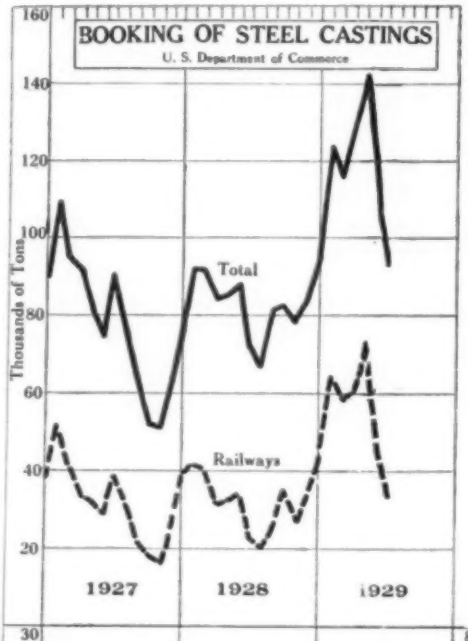
THE foundry industry has its stowaways. They are those benighted foundrymen, now fortunately becoming more rare, who ride upon their competitors' business ability. They wait with sharpened pencils for a chance word, or an intentional disclosure of another's price or estimate, then ride merrily to an order by cutting a bid. Cost systems to them are unknown or unheeded. These do not pay their own way. They stowaway and are carried along; but to their ultimate business starvation and the closing of their doors.

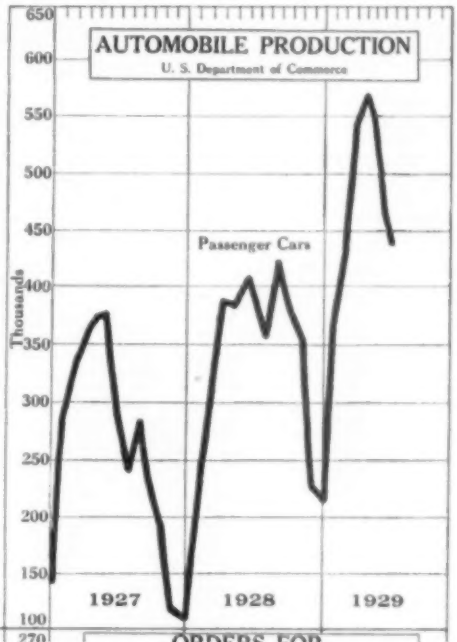
Trade Trends in Tabloid

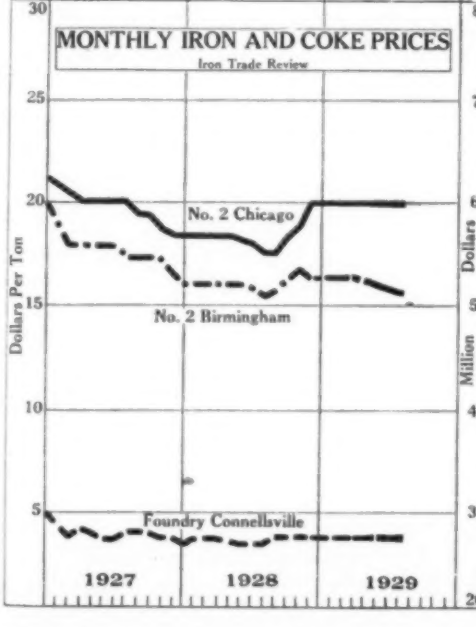
FOUNDRY activity has continued through the summer at a higher level than was expected. True, a slight decline in keeping with the usual seasonal dullness has been experienced, but signs of a pickup in castings demand already are apparent. Pig iron contracts which furnish a barometer for expectations support this belief on the part of foundry owners. Deliveries of iron and coke consumption, also have continued at a high rate. While freight car buying dropped in July, orders for more than 4000 cars are pending and freight loadings still continue far in advance of corresponding periods last year. Cast-iron pipe sales are satisfactory with a fair backlog of orders to carry the foundries well into the fall. Radiator, stove and furnace foundries are operating at a slightly decreased rate, but expect an early pickup. Agricultural expectations support an estimate of increased buying from rural sections during the fall and winter. Steel mills are operating at capacity. Building construction has declined slightly during August, although the July figures showed an increase over the previous month and also in comparison with July last year. Brass foundries are active in practically all districts and demand for plumbing goods and miscellaneous jobbing castings is holding strong. Foundries specializing on aluminum, also are active. Steel foundries in railway and machinery lines are busy.

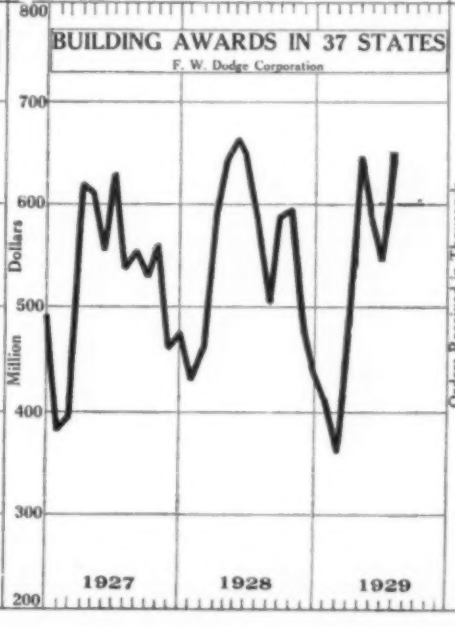
RAW MATERIAL PRICES
Aug. 21, 1929

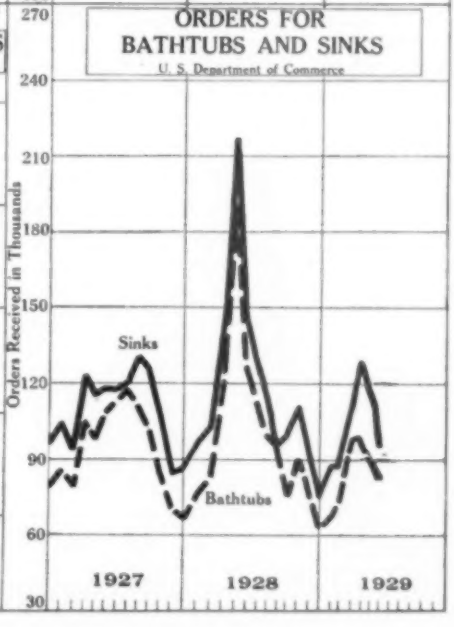
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	14.00 to 14.50
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville foundry coke	$3.75 to 4.85
Wise county foundry coke	4.25 to 5.00
Scrap	
Heavy melting steel, Valley	$18.50 to 19.00
Heavy melting steel, Pitts.	19.00 to 19.50
Heavy melting steel, Chicago	15.25 to 15.75
Stove plate, Buffalo	13.00 to 13.50
Stove plate, Chicago	11.50 to 12.00
No. 1 cast, New York	12.50 to 13.00
No. 1 cast, Chicago	14.50 to 15.00
No. 1 cast, Philadelphia	17.00
No. 1 cast, Pittsburgh	15.00 to 16.00
No. 1 cast, Birmingham	14.00 to 15.50
Car wheels, iron, Pittsburgh	16.50 to 17.00
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	17.00 to 17.50
Agricultural mal., Chicago	15.50 to 16.00
Malleable, Buffalo	18.00 to 18.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.50
Electro, copper, producers	18.00 to 18.12½
Straits tin	46.50
Lead, New York	6.75
Antimony, New York	8.87½
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.80











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

E J. Schwanhausser, for the past two years assistant manager of the Harrison, N. J., works of the Worthington Pump & Machinery Corp., has been appointed manager of that company's Buffalo plant. Mr. Schwanhausser is one of the youngest executives in the Worthington organization being 35 years of age. He joined the company while he was a student at Stevens Institute of Technology. During the summer vacation periods of 1912-13-14 he was employed in the various departments of the shops and on the testing floors at the Harrison plant. Immediately following his graduation, in 1915, he was made engineer of tests and erection. In 1917, he was transferred to the condenser engineering department and in 1919 he was promoted to shop equipment engineer. In 1920, Mr. Schwanhausser was made superintendent of the machine shops and in 1923 was appointed superintendent of the field erection department. He became engineering assistant to the manager at the Harrison plant in 1923 and was made assistant to the manager in 1927. Later he was promoted to assistant works manager which position he held until his recent appointment as works manager.

E. D. Spicer, superintendent of refrigeration department of General Electric Co., was made assistant manager of Schenectady, N. Y., works effective Aug. 1.

Charles W. Burger, formerly foundry superintendent Pangborn Corp., Hagerstown, Md., now is connected with the Adirondack Steel Foundries, Watervliet, N. Y.

James Anderson, formerly connected with the United Engineering & Foundry Co., Pittsburgh, has been named works manager of the Cooper-Bessemer Corp. plant at Grove City, Pa.

John L. Connors has been made assistant general manager and a director of the Galion Iron Works & Mfg. Co., Galion, O., a subsidiary of the Jeffrey Mfg. Co., Columbus, O.

L. J. Brown has resigned as executive vice president of the Oliver Farm Equipment Co., Chicago. Mr. Brown was formerly president and general manager of Nichols & Shepard Co., Battle Creek, Mich.

E. P. Sedgwick has been re-elected president of the Chicago Hardware Foundry Co., North Chicago, Ill. Other officers elected are as follows: E. B. Sherwin, secretary; J. W. Ellis, treasurer F. J. Sherwin, vice president and G. L. Brewster, assistant secretary.

Clyde L. King, president of the Atlanta Plow Co., Atlanta, Ga., has been elected president of the Southern Plow association. William E. Dunn, formerly executive secretary of the Southern Metal Trades association, has been elected secretary with headquarters in the Georgia Savings Bank building, Atlanta.

T. E. Golden, president of the Golden Foundry & Machine Co., Columbus, Ga., Horace Lanier, president of the West Point Iron Works, West Point, Ga., and H. A. Dean, Towers & Sullivan Mfg. Co., Rome, Ga., have been re-elected directors of the Georgia Manufacturers association.

W. H. Arnold, formerly assistant sales manager of the Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, has been made general sales manager succeeding C. A. Anderson, Jr., who became president of the company March 1. Mr. Arnold has been identified with the company since 1905.

J. E. Olson, at one time foundry superintendent the Bessemer Gas Engine Co., Grove City, Pa., and later serving in a similar capacity at the Moore plant of the Bethlehem Steel Corp., Elizabeth, N. J., now is foundry superintendent of the Hilles & Jones Works of the Consolidated Machine Tool Corp. of America, Wilmington, Del.

W. A. Grieves and H. Supp Jr. have been elected secretary and treasurer, respectively, of the Ohio Malleable Iron Co., Columbus, O., a subsidiary of the Jeffrey Mfg. Co., Columbus, O. Both men hold similar positions with the latter company. J. F. Davidson has been elected to the board of directors of the Ohio company.

Otto A. Seyferth, vice president in charge of operations, West Michigan Steel Foundry Co., Muskegon, Mich., which recently acquired the Austin Machinery Corp. of that city, has resigned from the board of directors of the Greater Muskegon Chamber of Commerce. He will have charge of operations in both plants of the organization.

William Tyler Ball, formerly connected with the Deere Harvester Works, Moline, Ill., on the engineering staff, has accepted a position as sales engineer with the Burgess-Parr Co., Moline, Ill. Mr. Ball will specialize in foundry products including brass, bronze, aluminum and special alloy castings and will be associated with the industrial development of a special corrosion resisting alloy made by the Burgess-Parr Co.

Sale of Commonwealth Steel Is Completed

With the filing of four quit-claim deeds at the Madison County, Illinois, recorder's office at Edwardsville, Ill., the $35,000,000 sale of the Commonwealth Steel Co., Granite City, Ill., to the new General Steel Castings Corp., Philadelphia has been closed. The deeds were filed by an abstracting company on advice from New York stating the deal had been closed at a conference in the offices of J. P. Morgan & Co. They conveyed the Commonwealth properties to General Steel Castings through an intermediary.

Equipment Orders Rise

The Index of gross orders for foundry equipment for July was 219.3 as compared with 177.3 for June, according to a recent report of the Foundry Equipment Manufacturers' association. The index of shipments for July was 182.1 as compared with 172.7 for June. Unfilled orders for July were 368.7 against 300.8 for June. The base is the average monthly shipments for the years 1922-23-24. Comparisons of monthly orders as presented by the Foundry Equipment Manufacturers' association follow:

Month	1926	1927	1928	1929
Jan.	168.2	180.4	132.7	180.5
Feb.	154.9	198.0	123.6	197.0
March	157.3	131.1	138.6	209.4
April	113.2	130.0	107.7	172.6
May	128.5	134.8	335.6	177.7
June	133.5	138.4	149.1	177.3
July	127.3	89.9	94.8	219.3
Aug.	141.2	106.4	278.0	.....
Sept.	114.0	80.4	170.0	.....
Oct.	140.5	98.0	185.0	.....
Nov.	133.4	95.8	197.8	.....
Dec.	181.0	106.8	166.5	.....

Obituary

Ernest Knefler, aged 49, president of the Knefler-Bates Mfg. Co., manufacturers of core binders, died recently at the Methodist hospital, Indianapolis, following an operation. Mr. Knefler started his business career in Indianapolis with the Cerealine Mills Co., and continued with that company until 1902, when he became associated with Hervey Bates and formed the American Hominy Co. Later he became president of the Knefler-Bates Mfg. Co. and vice president of Hurty-Peck & Co. Recently he became vice president of the Indiana Consumers Gas & By-Products Co., Indianapolis. Mr. Knefler was born in Cincinnati in 1880 and came to Indianapolis when a small boy. He was a veteran of the Spanish-American war and was the son of Fred Knefler who served as a brigadier-general in the Civil war. He was a member of several prominent Indianapolis clubs.

Harry E. Kies, 60, general manager of the malleable plant of the American Radiator Co., Buffalo, died Aug. 10, following a week's illness.

Ambrose Monell, son of the late Ambrose Monell, founder of the International Nickel Co., New York, was killed Aug. 2 in an airplane accident at Greenwich, Conn.

ERNEST KNEFLER

Charles H. Schroder, for 27 years secretary of the Murray Iron Works Co., Burlington, Ia., died recently at an age of 62 years. He had been connected with the Murray company for 47 years.

Charles Thielgas, for 15 years foundry superintendent of the A. E. Martin Foundry & Machine Co., Milwaukee, died Aug. 4. Mr. Thielgas formerly was in the employ of the Edward P. Allis Co. and the Greenslade Foundry Co., having been superintendent of the latter for 30 years.

Nicholas Newnam, president of the Newnam Foundry Co., Kendallville, Ind., died unexpectedly Aug. 10. He was 51 years of age and was one of the prominent business men of the city. Mr. Newnam was associated with the Flint & Walling Co., Kendallville, Ind., for 25 years, his father N. B. Newnam being one of the founders of the company. Several years ago he left the Flint & Walling Co. and organized the Newnam Foundry Co., in which business he continued until his death.

Fusion Welding Corp., 103rd street and Torrence avenue, Chicago, a subsidiary of the Chicago Steel & Wire Co., has taken over the sales of welding rod manufactured by the latter company.

Foundry Association Directory

American Foundrymen's Association
President, S. T. JOHNSTON, S. Obermayer Co., Chicago; secretary-treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England
President, J. A. DUNCAN, Wm. Duncan & Sons Co., 166 Liverpool street, East Boston, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen
President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club
President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club
President, DAVID G. ANDERSON, Western Electric Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co. 2563 W. Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association
President, CARL S. NEWMAN, Union Mfg. Co., New Britain, Conn.; secretary CHARLES S. PARKER, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
President RUSSELL M. SCOTT, Packard Motor Co., Detroit; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., Detroit. Meetings third Thursday in each month at appointed place.

East Bay Foundrymen's Association
Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Gray Iron Institute
President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; Secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute
President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association
President WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association
President, J. L. CARTER, Sachs-Barlow Foundries, Inc., Newark; secretary W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association
President CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.
President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smead avenue, Toledo, O.; secretary-manager, E. F. SCOTT, 418 Penton building, Cleveland.

Philadelphia Foundrymen's Association
President, C. F. HOPKINS, Ajax Metal Co., Philadelphia; secretary EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association
President, L. W. MESTA, Mesta Machine Co., Homestead, Pa.; secretary-treasurer WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
President, F. W. KIRBY, John Deere Spreader Works, East Moline, Ill.; secretary-treasurer, J. P. BOADEN, Union Malleable Iron Co., East Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club
President, HORACE R. CULLING, Carondelet Foundry Co., St. Louis; secretary-treasurer, LEO J. FILSTEAD, John C. Kupferle Foundry Co., St. Louis.

Southern Metal Trades Association
President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Steel Founders' Society of America
President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York.

Tri-City Technical Council
Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY. Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
President, WILLIAM E. LOBERG, American Hoist & Derrick Co., St. Paul; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club
President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Weldon Foundry Co., Wayne, Mich., has changed its name to Enot Foundry Co.

Hayes Pump & Planter Co., Galva, Ill., recently reopened its foundry which had been closed for about a month.

Chicago Steel Foundry Co., 3720 South Kedzie avenue, Chicago, has been issued a permit for alterations to substation.

Michigan Brass & Iron Works, Lansing, Mich., is planning to rebuild that part of its foundry which recently was destroyed by fire.

Kunkle Valve Co., 119 North Clinton street, Fort Wayne, Ind., has awarded a contract for a 2-story addition.

Canadian Steel Foundries Ltd., 307 Craig street west, Longue Point, Que., has awarded the contract for a 2-story plant addition.

D. M. Platnick of Platnick Bros., Bluefield, W. Va., recently purchased property at Big Stone Gap, Va. and plans to build a foundry.

Auto Specialties Mfg. Co., St. Joseph, Mich., has awarded the contract for extensive plant additions to Owens Ames Kimball Co., Grand Rapids, Mich. (Noted July 15.)

Morgan Brass Foundry, Lincoln avenue, Providence, R. I., has plans for rebuilding its plant recently damaged by fire. New equipment will be required.

Lycoming Mfg. Co., Williamsport, Pa., has started construction of a 2½-story foundry addition, 43 x 320 feet. Estimated cost is about $150,000. Charles W. Feil is the contractor.

Northwestern Motor Co., Starr avenue, Eau Claire, Wis., has started work on the erection of a 1-story addition, 42 x 125 feet, to its gray iron foundry.

Hayes-Custer Stove Co., Bloomington, Ill., which recently completed a building program, contemplates a new expansion program which would substantially increase its production.

Geneva Foundry Corp., Geneva, N. Y., has acquired land adjacent to its plant and plans construction of a plant addition. Machinery and equipment will be installed.

Industrial Pattern & Foundry, New York, has been incorporated with $2100 capital, by H. T. Weeks, 18-30 Astoria avenue, Long Island City, N. Y.

McWayne Cast Iron Pipe Co., 3700 North Eleventh street, Birmingham, Ala., has awarded a contract for a new office building in connection with its pipe plant.

Akron Foundry Co., Akron, Ind., which recently completed a new foundry, began operations Aug. 2. The first operations will be devoted to the production of hatchets. Stoves will be turned out later. (Noted Aug. 15.)

Keene Foundry Co., Griffith, Ind., will start immediately on an expansion program, which will increase its output more than 30 per cent. Estimated cost is $25,000. L. E. Keene is president.

Montreal Foundry Ltd., Montreal, Que., has been incorporated to manufacture and deal in iron, steel, brass and other metals with $199,000 capital, by William Bayliss, Archibald S. Wilson and Romeo Leblanc, all of Montreal.

Monterrey Iron & Steel Co., Monterrey, Nuevo Leon, Mexico, has completed an addition and is installing equipment for the manufacture of metal wheels for railroad, street railway and mine cars.

North Shore Foundry Co., Greenfield avenue, Waukegan, Ill., has been incorporated with $50,000 capital by John Rause Jr. to manufacture and sell castings, iron, steel, copper and brass products.

Mackenite Metal Corp., Fieldsboro, N. J., has been incorporated with 1000 shares of common stock to manufacture metal castings, by Romulus P. Rimo, American Mechanic building, Trenton, N. J.

Gogan Machine & Foundry Co., 1440 East Fifty-fifth street, Cleveland, has awarded the construction contract for a plant addition, 40 x 72 feet, to the J. L. Hunting Construction Co., Guarantee Title building, Cleveland. Estimated cost is about $70,000.

Mueller & Co., Decatur, Ill., manufacturer of plumbing fixtures, awarded contract for an office and warehouse building, 110 x 115 feet, at Atlanta, Ga., to Smith & Williams Co., 435 Irwin street, Atlanta. Estimated cost about $80,000.

Chemung Foundry & Supply Co., Erie street, Elmira, N. Y., has acquired adjoining property as part of an expansion program. It is planned to enlarge the present foundry building and connect it with a proposed addition to be built on the newly acquired land.

St. Marys Foundry Co., St. Marys, O., has bought the building and grounds of the Boos Oil Engine Co., adjoining its plant. It will be used for future expansion of the purchasing company. The building contains 20,000 square feet of floor space.

Rahn Metals Ltd., North Bay, Ont., has been incorporated to manufacture metal products, and to carry on a general foundry business, with $50,000 capital, by Hugh A. McEwen, George C. Rahn and John H. McDonald, all of North Bay.

Calumet Foundry & Machine Co., has leased the plant of the Green Engineering Co., East Chicago, Ind., which recently was closed. The activities of the latter company, a subsidiary of the Combustion Engineering Corp., Philadelphia, have been moved to the Philadelphia plant of that company.

Erie Foundry Co., Erie, Pa., manufacturer of forge shop equipment, recently received an order for a 30,000-pound steam drop hammer from the Henry Vogt Machine Co., Louisville, Ky. Total weight of the hammer will be 700,000 pounds, the anvils being made in two sections each weighing 250,000 pounds.

National Bronze & Aluminum Foundry Co., East Eighty-eighth street and Laisy avenue, Cleveland, awarded contract through Earnest McGeorge Inc., architect, 3030 Euclid avenue, for a 1-story warehouse and plant addition, 71 x 109 x 200 feet, to the Arthur H. Binns Co., 7504 Carnegie avenue.

Aluminum Co. of America, Oliver building, Pittsburgh, which recently purchased the Modern Foundry & Pattern Works, 3110 Adeline street, Oakland, Calif., plans adding a heat-treating department. Molding and aluminum die-casting departments also will be added at a later date.

Davis Foundry Co., Newcastle, Ind., reports business good and that July was a record breaking month for the establishment. George J. Hey, Cincinnati, is president of the company and William Davis, Newcastle, is vice president and general manager. The firm formerly was the Newcastle Foundry Co.

Michiana Products Corp., Michigan City, Ind., recently organized, has taken over the Chrobaltic Tool Co. and the Sheet Steel Products Co., both of Michigan City, and will continue both, with enlarged facilities. O. M. Carry is president, with offices in Chicago, and W. B. Sullivan is vice president and general manager, with offices at Michigan City.

The Specialty Brass Co., Kenosha, Wis., manufacturer of sanitary creamery fittings and milk pumps, has decided to transfer its plant at Albany, N. Y., to Kenosha to consolidate all production activities. Concentration of equipment at Kenosha will increase production 30 per cent with a 20 per cent addition in payroll. C. M. Anderson is president.

Wisconsin Malleable Iron Co., 94 South Bay street, Milwaukee, is planning immediate reconstruction of several buildings recently damaged by fire. The core-room, shipping room, annealing house, boiler-house, pattern shop and carpenter shop units are affected. W. H. Osborne is president, and W. T. Westenberg treasurer.

New Trade Publications

MANUFACTURING TRENDS—Trundle Engineering Co., Cleveland, has issued the first of two bulletins on economic and manufacturing trends and their meaning.

LUBRICATION—Alemite Corp., Chicago, has issued a bulletin on industrial lubrication, covering various phases of lubrication of machinery in an economical and efficient way.

TRUCKS—A broadside by the Lewis-Shepherd Co., Boston, illustrates the various types of its lift truck and accessories and their application to various industrial uses.

MOTORS—Totally enclosed, fan cooled, direct current, shunt and compound wound continuous duty motors are described and illustrated in a 4-page folder published by the General Electric Co., Schenectady, N. Y.

STEEL CASTINGS—Nugent Steel Castings Co., Chicago, devotes a current bulletin to castings for gasoline motive power for railroads. Dependability and resistance to wear and breakage are stressed.

PULLEYS—Henry Lindahl Foundry & Machine Co., 5900 Ogden avenue, Chicago, has published a catalog of the pulleys it manufactures. These articles are made from cast iron, semi-steel, steel, wood and paper. The bulletin shows illustrations of various type pulleys and specifications and prices.

GRINDING WHEELS—Blanchard Machine Co., Cambridge, Mass., has issued a booklet describing grinding wheels of its manufacture for use on its grinding machines. A table shows what wheels are recommended for each class of work. A number of pictures show typical work with wheel data for each.

ARC WELDING—General Electric Co., Schenectady, N. Y., has issued two folders on its welding equipment. One describes its travel carriage for automatic arc welders with a single welding head for light and meduim welding and with a double welding head for heavy duty welding. Another folder describes its continental gas-engine-driven arc welder with a rating of 200 amperes, 25 volts with a temperature rise of 50 degrees in 1 hour.

SILENT GEARS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., presents a bulletin on its silent gears and pinions. It describes the material from which they are made, its history, design, application and distinctive features. Descriptions and illustrations are given. Data for engineers instruct the engineer in the proper application to various classes of work. Formulas and tables are based on the recommended practice of the American Gear Manufacturers association.